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No. 14, Original

In the Supreme Court of the United States

OCTOBER TERM, 1930

No. 14, Original

THE UNITED STATES OF AMERICA, PLAINTIFF

v.

THE STATE OF UTAH, DEFENDANT

ABSTRACT IN NARRATIVE FORM OF THE TESTIMONY TAKEN BEFORE THE SPECIAL MASTER, AND FILED IN THIS COURT BY HIM

IN TWO VOLUMES

VOLUME 1

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VOLUME 1

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CLYDE L. EDDY

For complainant

(Record, vol. 1, pp. 31–97)

Resides at 22 Litchfield Road, Port Washington, Long Island, New York. Sales Executive E. R. Squibb & Son. Forty years old. Graduate in Pharmacy. Has been Editor of the Druggist's Circular, New York. Two years' naval service. Made pictures in France for the War College.

1927 made a trip on Colorado River. First saw river in 1909. Had always been his dream to go

down some bad river; in 1919 decided on the Colorado River. For next eight years read and studied; studied Dellenbaugh's Books, The Romance of the Colorado and Canyon Voyage. Emory Ellsworth Kolb's book. Reports and publications of U. S. Geological Survey. During spare time worked on his expedition. (R. 32–33.)

Frederick S. Dellenbaugh is the outstanding authority on the history of the Colorado and its exploration.

Carried with him the Romance of the Colorado River and the Canyon Voyage.

Identifies Compl. Exh. No. 13, Romance of the Colorado River. Photographs in the book of portions of the river are correct reproductions of what he saw on the river. (R. 31–34–36.)

Identifies Compl. Exh. No. 14, A Canyon Voyage, Second Powell Expedition down the Green and Colorado Rivers. Exploration on land by F. S. Dellenbaugh. (R. 38.)

Since making his trip has continued his studies and kept in touch with such things as have happened in the meantime.

Compl. Exh. No.—Through the Grand Canyon, from Wyoming to Mexico, by E. S. Kolb, published 1927, identified by witness. Kolb was known as an explorer and a historian of the Colorado River. (R. 38.)

Delivered lectures on Colorado River at the American Museum of Natural History, New York;

Columbia Institute of Arts and Sciences, New York; Brooklyn Institute of Arts and Sciences, Brooklyn; Columbia University Club; Princeton Club; Lyric Theatre, Baltimore; and various other places. Member Explorer's Club, New York.

All previous expeditions had gone down at low water, but his studies and experiences of Powell, Stanton, and others prevailed him to make trip at relatively high water; this would make for more danger but better speed and less work. (R. 39.)

Designed boats after those used by Powell and Stanton. His two large boats were 22 ft. long, 5 ft. beam, built of half-inch Mexican mahogany, on very heavy oak ribs and keels, having three water-tight compartments, forward, amidships, and aft, and intended to be unsinkable. The small boat was 16 ft. long, built of ⅝ in. cedar, on same heavy oak ribs and keels, decked over for 4 ft. at each end, and had a splash board, but no water-tight compartment. (R. 40.)

His crew of 9 men were selected from 150 applicants of college-trained men, as his war-experience led him to believe they would stand up better than tough citizens. (R. 40.)

He secured the services of Parley Galloway, who had grown up on the river. An International News Service camera man joined the party at Greenriver, Utah, and he also hired a hobo at Greenriver. The party left Greenriver with thirteen men and three boats.

One of his crew had navigated the Mississippi and Missouri Rivers for practically the entire length; another had been on the Red River at flood times, and the remainder had had canoe and general boating experience. (R. 41.)

The larger boats weighed, unloaded, about 1,000 pounds each and cost $950 each, f. o. b. New York, and the small boat, unloaded, approximately 800 pounds, cost $350 f. o. b. New York.

The expedition left Greenriver, Utah, June 27, 1927.

Compl. Exh. No. 16 is photograph taken where boats were launched, shows the two bridges at Greenriver. The Denver & Rio Grande Railroad crosses the river at that point. (R. 42.)

Compl. Exh. No. 17 is photograph of boats and some members of crew. (R. 43.)

Compl. Exh. No. 18 is photograph taken from river, showing Dellenbaugh Butte, between Greenriver and the mouth of the San Rafael, 18 or 20 miles below Greenriver. (R. 43–44.)

On launching the boats the water was high, and they were immediately in very swift water and had some difficulty in keeping clear of the bridge pilings. The river swept them down below the bridges and for a moment threatened to pile them upon a willow-fringed sandbar in the middle of the river. They floated to a point where there is a sharp bend, down about five to eight miles. The water piling against the bank on the right shore

deflected and swept directly across the channel, forming a moving amount of water; the apex of the current where river is so swift seemed to pile up, like a little ridge of water, three or four feet high; to sweep the boats around and get through this apex, without being swept on to the opposite bank, required rather skillful navigation.

The water in the river was excessively muddy; could not see an inch below the surface. In places of less declivity, the water flows fairly smoothly, but rocks can not be seen and are bumped into. When they decided to run to shore one man stood up on the forward deck to help to get to shore; as they approached the shore the boat struck a submerged rock, tilted the boat, and threw him into the water. This is mentioned to point out the impossibility of seeing the rocks beneath the surface.

They run into sandbars at a number of places between Greenriver and the junction of the two rivers, and there are many of them in that stretch of river. These interfered with the navigation of the boats to the extent that it was necessary to leap overboard, push the boats off into deep water, and guide them carefully as the swift water caught the boats again. (R. 44–45.) One man habitually wore a bathing suit; some cut their trousers midway between the knee and hip, but they were always ready to go overboard at any time. (R. 44–46.)

Met no other boats in this stretch of river, and saw no other people. On the east bank of the river

saw a ranch house, but to him the country seemed without population or habitation.

Compl. Exh. No. 19 is photograph of second day's noonday camp, in the relatively open country between Labyrinth and Stillwater Canyons. (R. 46.)

Compl. Exhs. Nos. 20 and 21 are typical views of the canyons, river going through Labyrinth or Stillwater; these Canyons very similar. Photo made to show amount of driftwood in river, indicating high water. (R. 47.)

Compl. Exh. No. 22 is photograph taken at lower end of Bow Knot part of Labyrinth Canyon, where the River forms a loop, and it is about 800 ft. from the upper end of loop across this plateau to other end of the loop, but several miles around by way of river.

In navigating Labyrinth Canyon experienced a steady rise in level of water. Would tie boats among the rocks when running ashore at night, and in the morning the river would have come up from one to three or four feet, and they would have difficulty in getting boats to shore to load, in launching. On account of the high water, the declivity, and the great amount of water at every bend in the river, they were threatened with being swept against the outer cliff; where the river flows against the cliff, the outer bank has no slope, just sheer wall. The force of the current was so great they had difficulty each time in keeping from striking against the cliff.

The driftwood would pile up against the rocks and cause additional difficulty in running the boats. There was driftwood two or three feet in diameter and 20 to 30 ft. long, and they were swung by this pile against the rocks. The signal was given to drive to the boat clear, but the river was so full of driftwood they could not get the oars into the water. Driftwood consisted of small pieces and logs up to 20 to 30 ft. in length. (R. 48–50.)

Compl. Exh. No. 23 is typical view in *Labyrinth* and *Stillwater Canyons*. Formation very much alike. Palisades rise almost sheer from the edge of the river, almost perpendicular to a height of 500 to 800 ft. (R. 50.)

Compl. Exh. No. 24 shows junction of the Green and Colorado Rivers. The walls are about 1,300 ft. high; river 200 or 300 ft. wide (according to the Geological Survey), 25 or 30 ft. deep. The picture shows relatively high water prevailing on account of driftwood. The picture compared with pictures by other expeditions, and height of water along the edge indicates a period of high water. (R. 50–51.)

This is the only place on the river where there was any great danger from falling rocks. There had been heavy rains, and probably a dozen or fifteen heavy rocks came crashing down as they stood there. Spent a day and a half in that place. (R. 51.)

Between *Greenriver*, Utah, and the *confluence* of the two rivers saw no other boats, no other people. Ran on sandbars; did not get big floods in that stretch. Floods occurred in Cataract Canyon.

One difficulty that is typical is that in trying to get ashore, at one place, water was so swift could not do so, but landed possibly a quarter of a mile below. (R. 52–51.) This point named by Powell, Twin Alcove, located in Labyrinth or Stillwater Canyon.

Water excessively muddy; compelled to allow the water to settle in the canteen, then drink it hurriedly, as teeth gritted with sand; canteens would get full of dirt.

No "holes" in that stretch of river. Only contact with waves was at the point where the river in sweeping up against bank; was pushed diagonally across to the other side. (R. 52.)

Compl. Exh. No. 25 is photograph made 3½ miles below the junction, a mile above Cataract Canyon, the first rapid. (R. 53.)

Compl. Exh. No. 26 is photograph of Rapids No. 1, Cataract Canyon. First rapids noted by Government on Geological Survey Maps. (R. 53.) About 4½ miles from junction of the rivers. (R. 53–54.) Although Brown lost a raft with provisions in this rapid they were able to control things; it was relatively easy, and they ran it, getting through very nicely.

Compl. Exh. No. 27 is photograph intended to indicate character of the river at a point between Rapids Nos. 1, 2, and 3. First rough water they came to; it is just typical. Later on there were many miles of such places. (R. 54.) Ran Rapids Nos. 1, 2, and 3 out beyond the rough water place.

Compl. Exh. No. 28 is photograph of expedition lining one of the large boats around the upper portion Rapids No. 5. In coming to a rapids, too rough to run through, boats are run ashore; long lines are then tied on bow and on stern of each boat, with men holding lines; the men get out in the river to lift the boat over; boats were jockeyed down along the shore, the men in the river pushing the boat around and out along the rocks near shore. Lining was found to be very difficult and dangerous operation. (R. 55.)

Compl. Exh. No. 29 is photograph representing the lining of the boats. The weight of the water is one thing that makes lining difficult and dangerous. Water just splashing over him carried so much sand and silt his pockets would fill up with sand; he cut them off. In places where it was necessary to line, pockets would fill with silt and sand, and clothing be torn off and carried away and buried. Even when a man is in the water up to his knees, the force and weight is so great will sweep him off his feet; this adds greatly to the difficulty and danger of lining. The major difficulty was in

lining boats. (R. 56.) Compl. Exhs. Nos. 28 and 29 (photographs) were taken at the same rapids. (R. 56–57.)

Compl. Exh. No. 30 is photograph showing a "hole" knocked in the side of the small boat named "Dellenbaugh" while lining the boat around.

In the river it frequently happens that the swift current will come between the shore and the bow of the boat, the bow suddenly starts toward the middle of the river; it will then be swept by the current 30 or 40 ft. out; and then you draw bow to the shore, it turns towards you and the current dashes it back against the shore and smashes the boat, as happened in that instance. (R. 57.)

Compl. Exh. No. 31, photograph of the fifth bad rapids in Cataract Canyon. (R. 58.) Also shown in Compl. Exhs. Nos. 26 and 9.

They came to No. 4 (fourth bad rapids) and decided to run it through, but realized it would not be safe to run the fifth. The rapids run together at high water, the tail end of one almost running into the next one. The boats so filled up with water going through No. 4 rapids, one boat could not get to shore and was swept through No. 5 rapids; it got through but had a large hole in it and was repaired. Other two boats made shore. (R. 58–59.)

Compl. Exhs. Nos. 32 and 33 are photographs indicating character of river through Cataract Canyon, at Rapids No. 5 or 23.

Compl. Exh. 31 shows large logs which have been swept down. (R. 59–60.)

Compl. Exh. No. 34, photograph showing type of walls and width of river in Cataract Canyon. (R. 60.)

Compl. Exhs. Nos. 35, 36, and 37 are photographs showing fairly easy rapids in Cataract Canyon. (R. 61.)

The expedition encountered fifty to fifty-five bad rapids in the 40-mile length of Cataract Canyon. Rapids are pretty apt to be where indicated by the Government. High water conditions different from those prevailing at the time of making the Government maps. (R. 61.)

Compl. Exh. No. 38 is photograph illustrating a "hole." A "hole" is formed by water coming down over a large boulder out in the channel; in pouring over it the water drops into the "hole" below, forming a waterfall in middle of river. Plunging down, the water circles around forming an eddy, comes back and ducks under again, the chief danger of a "hole." Logs ten or fifteen feet long are held in a hole for hours, are thrown to bottom, scrape against the rocks and come up again. In going toward them from above they can not always be seen, and in his estimation, these "holes" are one of the principal dangers in the river, because you can not always see them when you are going down toward them from above.

The large 22 ft. boat was swept down toward a "hole," too late to avoid it, was swung around, bow first plunged over the rocks, then ran submerged a

fraction of a minute; the forward cockpit was level full of water. Bails had been thrown out, but bailed with hands and hats, and thus kept it from filling and sinking. "Holes" are highly respected by river men. (R. 62.)

Compl. Exh. No. 39 is photograph of Rapids No. 23. It was at this point flood struck expedition.

They knew they were in danger of sudden floods; made it a point to sleep at edge of water. The night of July 5th were awakened by water sweeping over feet and legs. Found boats hammering on the rocks. If boat permitted to grind back and forth, because of weight and velocity of the water, hole is ground through the bottom of boat. Part of the kitchen stuff had floated away; saved what they could and dragged boats and blankets up on the rocks. Between midnight and dawn hauled the boats 25 or 30 or 40 ft. up the steep slope, water following them all the way. Water began to recede about dawn, and receded point it had been before flood by two or three o'clock in the afternoon. When leaving Greenriver water not over 20,000 second-feet; reached a point of 119,000 second-ft. during flood. Water line in Glen Gorge observed, and high water mark 20 to 40 ft. above level they found going down, indicating a rise of 20 to 40 ft. in one night in Cataract Canyon.

Flood of 1884 had lodged driftwood 100 ft. above level of water. (R. 63–64.)

Compl. Exh. No. 40 is photograph of type of camp; type of sandbar found frequently at edge of water; type of slope preferred for camp, offered opportunity of dragging boats up on rocks in event of flood.

Photograph shows provisions and camp equipment laid out to dry; impossible to keep things dry even in waterproof boats. Things got wet from holes smashed in boats; stopped occasionally to dry out equipment. (R. 65.)

Compl. Exh. No. 41 is photograph showing type of walls and impossibility of climbing out in event of shipwreck. Shows one of larger boats. This rapids is above No. 22; it is either 18, 19, 20, or 22. No difficulty getting through this point. (R. 65–66.)

Compl. Exh. 42 is photograph of Gypsum Canyon, side canyon entering Cataract Canyon on left. Type of walls and character of river shown at that point. (R. 66.)

Compl. Exhs. 43, and 44 are photographs at point where Dark Canyon enters Cataract Canyon, and the rapids are to be found between Miles 182 and 183, on Sheet No. 12 of river plan and profile maps of Colorado River. Here river sweeps against right or west bank, which is a sheer cliff. A side channel was found in the pile of débris washed out of Dark Canyon; it seemed easier to line boats through side channel than to run the rapids. Good

deal of declivity and velocity of current in side canyon. In lining boat through, currents pulled it away from the men holding it, was swept up little channel toward main body of river, with one man holding on to it; swung down into the back water on the downstream side of pile of débris, thrown on down shore, saving the man and boat. This rapid is known as Dark Canyon rapids. (R. 67–68.)

Compl. Exh. No. 45 is photograph of. Narrow Canon. River flows in ordinary fashion, no bad rapids. This is below and out of Cataract Canyon. (R. 68–69.)

Compl. Exh. No. 46 is photograph made at junction of Fremont (Dirty Devil on some of older maps) River and Colorado Rivers, showing type of country for about six or seven miles. (R. 69–70.)

Compl. Exh. No. 47 is photograph made at point where river passes Utah State line into Arizona; shows type of river and country; water the same on both sides of State line. (R. 70–71.)

Glen Canyon between Fremont River and head of Grand Canyon, approximately 186 miles. Encountered nothing but sandbars, quicksand along shore, bad camping places. (R. 71.)

Encountered a sand storm; heavy wind blows just about supper time, fine sand gets into everything; not a great danger, but a discomfort. (R. 72.)

Compl. Exh. No. 48 is photograph showing typical view of Glen Canyon where walls are relatively low. (R. 72.)

Compl. Exh. No. 49 is photograph showing typical canyon walls; principally sandstone; river has cut steep wall banks, especially on outer banks; banks rise from 150 to 400 ft. above level of water. Steep walls sides. Walls below steep and of igneous rock. (R. 73.)

The three boats had a draft of 14 to 18 inches. (R. 73.) Did not encounter any other boat and saw only man between junction of Green and Colorado Rivers down to Lees Ferry. Five miles below mouth of Fremont River saw a cabin along shore; found William Carpenter, a miner and trapper, living there alone. Secures supplies every two or three months, bringing them in by horseback; no road down to river at that point. (R. 74.)

It took the expedition about sixteen days to make the trip from Greenriver, Utah, to Lees Ferry. (R. 74.)

No town at Hite; found an old building that had evidently been used for a post office; saw no one; none of shacks inhabited.

No town, store, or post office at Lees Ferry. Ferry; man and family and two brothers lived there. A ferry boat and two or three small boats; small boats used to cross river when did not want to use ferry. (R. 74–75.)

Cross-examination (R., Vol. 1, pp. 75–97):

Encountered first rapid water about eight miles below Greenriver, place where turn in river; considerably fast water.

First rapids, No. 1 rapids. (R. 75–76.) No member of party had previously been along the river before except Parley Galloway. All three boats went through the rapid water safely.

After Cataract Canyon had easy going down to Arizona-Utah Line. "Easy Going" relative term, compared with Cataract Canyon, and there were two rapids between Cataract Canyon and State line; the rapids in Glen Canyon called easy rapids and experienced no difficulty. (R. 76–77.).

Differentiates between rapid water and rapids. Rapid water simply fast-flowing water which offers no difficulty. Rapids have a sudden sharp drop; may be rocks in the way, and have to steer with very great care.

In Grand Canyon boats tilted and tipped so that water was shipped.

Stretch of river from Cataract Canyon to Utah line not typical, easy stretch of water at those two points. (R. 77–78.)

Lined boats at five rapids in Cataract Canyon. (R. 78.)

In lining boats you run them ashore at head of rapids and turn them about so that the stern is downstream. The bow line and stern line, are then taken on out by men on shore; then the force of the current carries boat down along the shore and down the stream. Exceeding care is needed to keep boat from piling on rocks because force of current is so great; necessary for men to wade and

lead boat. Danger of current coming between bow of boat and shore, turning boat back toward the middle of stream, dashing it on rocks. All boat wrecks he knows of on river, have been caused by being caught in "holes" or whirlpools while lining large rapids. It is an extremely difficult and dangerous operation. (R. 78–79.) Boats are always unloaded when lining, and at first rapids, the stuff was carried along rocky shore from half to three-quarters of a mile; boats then lined down to lower end of rapids. (R. 79.)

Second rapids were one of worst encountered; indicated on map as a mile or more in length; necessary that equipment be carried along shore for practically a mile.

Where two rapids come together is the next bad point; boats lined the distance of the two rapids, probably three-quarters of a mile. Lined boats four times only, as he remembers. (R. 80.)

Holes were made in boats at Rapids No. 5, the fifth bad rapids they came to. At Fourth of July Rapids one large boat completely overturned while lining and necessary to let boat drift down out the hole; hatches found broken in when boat came to shore. The second large boat, "Coronado," was badly injured going through this rapids; had to be patched. These were the major accidents to boats going through the Cataract. (R. 81–82.)

Trip made during high water; nothing in Cataract Canyon to indicate recent higher stages of

water. Experienced torrential rains; water went up banks for distance of 30 ft. at slope shown in Compl. Exh. 40. Height of rise depends on width of canyon; where canyon wider, rise would be 10 ft.; where narrower, rise up to 30 ft. (R. 82.) River rose vertical much more than a foot; pulled boat probably 50 ft. up the slope. Compl. Exh. 45 illustrates height of wall where water rose 40 ft. (R. 83.)

A "hole" is shown in Compl. Exh. No. 38; water not quiet on either side. Rock completely covered by water, can not be seen in picture. Boats were lined there with great danger of getting in hole (R. 84.) A "hole" looks like a hole as you come down to it; it differs from a whirlpool, which is under the rock. A "hole" is called such because it looks like one. (R. 84–85.)

The most turbulent scenes of river done by motion picture camera. On second trip had a fast camera and took pictures of most turbulent section; pictures in another book. (R. 85.)

With exception of Rapids No. 5 and the "hole," pictures do not show most dangerous places. At long bad rapids it was raining, no pictures taken. Was most interested in getting Expedition through and not in pictures. (R. 85–86.)

At stage of water on trip, worst rapids in Cataract Canyon, probably No. 22, where he saw the hole with No. 23 so close below it. No. 5 Rapids also bad. (R. 86–87.) Dark Canyon is a bad rapids. (R. 87.)

Compl. Exh. No. 28 shows approach to or upper part of Rapids No. 5, but not the rapids. (R. 87.)

Compl. Exh. No. 29 shows approach No. 5 Rapids.

Compl. Exh. No. 31 only a fair representation of Rapids No. 5.

Third most troublesome rapids in Cataract Canyon is where river drops 115 ft.; designated by Government as a mile in length. Lining all day; made no picture; water was very swift.

Rapids Nos. 22 and 23 both bad; has picture of No. 22 and a distance picture of No. 23. (R. 88.)

There are 54 bad rapids indicated on government map. He made photograph of few of them. (R. 89.)

Information as to second feet of water during flood obtained from gauging stations. Learned height of water at gage, and that the water at that height indicated about so much water. (R. 89.)

Side streams flowing into the Green River not of any consequence; San Rafael not much of river at that time of year. (R. 90.)

Combined flow of Green and Colorado at head of Canyon, 40,000. Amount of water in San Juan subtracted. Estimates amount of water in Cataract Canyon during flood 119,000 second-feet; water reading obtained at Lees Ferry. (R. 90–91.)

Two members of party were majoring in geology; also a man who is now an instructor in geology at Northwestern University, but no time was spent in geological studies. Occasional side trips were made into side canyons. In Labyrinth, climbed to rim.

Because of limited amount of rations, expedition went right through; it was a hurried trip. (R. 91–92.)

He is author of the book, "Down the World's Most Dangerous River," published in 1929 by Frederick A. Stokes Co., New York City. (R. 92–93.)

Redirect Examination (R., Vol. 1, pp. 93–97):

Supplies brought overland from Kanab to Lees Ferry; from railroad to trail at Grand Canyon. Expedition arranged for supplies before trip. The expedition continued to Needles, Calif., and the whole trip was completed in six weeks. (R. 93.)

It would be possible to get boats upstream in Glen Canyon from Lees Ferry to Dark Canyon Rapids, but it would be a hereulean task.

Boats could not be rowed up, they would have to be lined up, or pushed up at that time by very strong motors. (R. 94.) Because of quicksands along shore he does not think boats could be poled up. (R. 94.)

Unless a boat is swept down into the rapids, which happened to them several times, ordinarily they go ashore and make a survey of the rapids. Many times the river turns down to the side; you stand on deck of your boat, and many times the river disappears; boat is run ashore, and by walking down the edge of river whenever you can and then you pick out the channel. Can walk along shore in Cataract Canyon, but not in places in Grand Canyon. Then you return to boat which is

turned stern first and oars are then used as a brake and to guide boat away from rocks, holes, etc. (R. 94–96.)

His book, which carries imprint of Frederick A. Stokes & Co., New York City, is an accurate and correct story of travel down the river and the photographs contained therein were made at time of trip. (R. 96.)

Winter trip started at Lees Ferry and continued to Bright Angel Creek in Grand Canyon. Winter expedition and Government expedition only ones through there in about twenty years. (R. 96.)

Recross-Examination (R., Vol. 1, pp. 97–104):

Thinks a motor boat could go upstream from Lees Ferry as far as Cataract Canyon. (R. 97.)

Thinks motor boat could go upstream from head of first rapids in Cataract Canyon to junction of Green and Colorado; up the Green River to Greenriver, Utah; would be a great deal of trouble and attendant danger of sandbars and rocks. Almost anything is possible with men of strength and courage and ability. Could be done by competent men, but he can not say without mishap because he does not know. (R. 98–99.)

Lining is the equivalent of the old portage with lighter boats. In Grand Canyon necessary to carry the heavy boats out of river and skid on rocks. (R. 99.) Believes it better to have strong heavy boats; they stand rough heavy buffeting by water. (R. 99–100.) Size of waves is difficulty in going through rapids in high water with lighter boats.

Also you are apt to hit the concealed rocks. Going through these rapids his motion pictures showed that the boats were whirled around end to end. In case of that kind you want a stout boat that will fill up with water but not topple over. Even a big boat would topple over so quickly sometimes that we would not know what did it. There are whirlpools from shore that whirl your boat around in spite of all your efforts. At high water the river has an inconceivable power; it sweeps everything before it. He saw the remains of old dredges and the mine dumps, with the shaft, poles, etc. There are evidences of former mining operations on the river, but none there now at all. (R. 100–101.)

ARTHUR A. BAKER

For complainant

(Record, Vol. 1, pp. 105–128)

A geologist in the U. S. Geological Survey since 1921. Graduate of Yale University as mining engineer, specializing in geology.

During 1926, 1927, and 1928 spent five to six months of each year, conducting field examinations in or adjacent to Colorado and San Juan Rivers. (R. 105.) Mapped in detail territory east of Colorado River from Castle Creek to slightly below junction of Green and Colorado, area 1,000 square miles.

Compl. Exh. No. 55 is a report based upon his observations there. (R. 105–106.)

He has mapped from 110th meridian west, beyond junction of Colorado and San Juan Rivers, and Utah-Arizona Line; between 800 and 1,000 square miles in that area. (R. 107.)

From Moab to junction is a plateau country, bisected by the Colorado and tributary canyons; flat-topped divides or mesas between the canyons. Vegetation on top of mesas and in some instances in valley bottoms. Desert-type vegetation; scanty grass. Yellow pine and some spruce in higher mountains above plateau, such as La Salle and Blue Mountains. Vegetation desert-type, not very abundant.

Very few inhabitants in the Colorado country outside of Moab Valley and Castle Creek Valley; isolated settler, one or two ranches employing a few men; five or six ranches in Castle Creek Valley. In Colorado country would say there is less than 100 people outside Moab and Castle Valley, perhaps considerably less than that, less than 50. (R. 108–109.) No one living within ten miles of the river; no houses, no dwellings outside of old oil-well location, and they are not inhabited. (R. 109.)

Mexican Hat, on San Juan River, also known as Goodrich, consists of trading post and one family. (R. 110.) In the San Juan country, between mouth of Chink Creek and the Colorado River, aside from a few Indians, there are three families; one man dry farming; these are the only inhabitants in area of 800 to 1,000 square miles. (R. 110.)

Has been down the Colorado to oil wells, a distance of 28 miles. Trip made in a 16 to 18 ft. boat with an Evinrude outboard motor. On another trip, made in a boat of the Moab Garage Company; slightly larger boat.

Nothing was known about the channel, first trip down, continually running on sand bars and dodging rocks, jumping overboard and poling the boat over riffles.

Upstream, and both ways, boat operated with a man sitting on bow constantly, trying to pick the channel; sometimes he picked it, sometimes not. Would jump or fall overboard when they stuck.

Boat on second trip operated by Virgil Baldwin, who operated boats of Moab Garage. With his experience in picking channel, could not pick it constantly, had to watch carefully. Baldwin wore a bathing suit on this trip.

Heard of Moab barge being stuck on sand bar several times but did not see it. (R. 111.)

Cross-examination (R., Vol. — pp. 113–121):

Five people on boat second trip. (R. 113.) Moab Garage Company boats had no regular schedule; had certain amount of equipment to take down; soon as one trip was made would load up and start on another. (R. 114.)

When went on Moab Garage boat Virgil Baldwin might just as well have been in bathing suit; he had his trousers swept overboard. Virgil Baldwin was operating the boat. (R. 113.)

Greenriver, Utah, has a population of 800 to 1,000 people. His report (Compl. Exh. 55) says that a very small part of Southeastern Utah is suitable for farming, because of insufficient supply of water and lack of proper soil. (R. 118.)

Greenriver is in country just outside of the Book Cliffs. Rolling hilly country; shale flats nearly barren of vegetation. (R. 119.) Shale flats everywhere you look. (R. 119.) Thinks lot of the irrigated land is flood plain from the river. (R. 119.)

Region of Moab, there is flood plain and that land was built up out of flood plain; farther up river from Moab there is gravel and débris washed down from mountains; that is not good soil. (R. 119–120.) Road ten or fifteen miles to west of river which goes down to Literite Basin. (R. 120.) Made no study, analysis or examination of soil; examination confined to structural geology of region. (R. 121.)

Redirect Examination (R., Vol. —, pp. 121–123):

Good road from Greenriver to Moab. Road from Moab up to Thompsons on the railroad. Stage and freight line run over road. Branch to Valley City. (R. 121–122.) Road to Monticello, gravelled two-thirds of way. Monticello to Bluff, graded dirt road. Poor road west of Bluff. Went into San Juan country by automobile. (R. 122.) Used saddle horses daily when mapping. Saddle horses at Mexican Hat. (R. 122–123.)

Topography of Colorado Plateau does not permit free travel by automobile, horseback, or on foot.

Cliffs nearly impassable. Many miles between trails that permit descent into canyons. Inaccessible points not reached by boat, as people in that country not using boats. (R. 123–124.) People run cattle in there. (R. 124.)

Went by boat from Moab to oil wells so they could see the things along the river, follow things successively down the river which he could not do on horseback. (R. 125–126.)

All of surveys shown on map within the last twelve years. (R. 127–128.)

WILLIAM GLENN HOYT

For Complainant

(Record vol. 1, 2, pp. 136–358)

(Vol. 23, pp. 4115–4136, 4142–4161)

Resides in Washington, D. C. A hydraulic and civil engineer. Age forty-three years. Graduate Cornell University, 1909. With U. S. Geological Survey since 1909. On lake and river surveys, 1904, 1905, 1906, and 1907. As assistant engineer, U. S. Geological Survey, he was engaged in stream measurement work 1909, 1910, 1911, 1912 at Albany, N. Y. 1912 to 1921 he was district engineer, U. S. Geological Survey, in charge of Upper Mississippi District, and engaged on river and stream flow characteristics in Minnesota, Illinois, Iowa, and Wisconsin. From 1921 to date, consulting engineer, Conservation Branch, U. S. Geological Survey, on river and general hydraulic work in the Northwest, Idaho, Oregon, and Washington. Ex-

perience since 1909 has been relative to rivers. Experience has been on principal rivers of the United States. (R. 136–137–138.)

An entire river basin has to be studied as a whole in practically all hydraulic problems. It is a recognized principle of hydraulic engineering that in the study of a particular river the entire basin must be considered. Study is made of the stream flow, the amount of silt, sediment, driftwood, and other conditions dependent upon the tributary; and, in fact, the entire basin. (R. 138.) In all the Geological Survey work basins as a whole are studied to arrive at the answer to any one particular point.

At the direction of the Secretary of the Interior, he made an examination of the Colorado River from Moab, Utah, to its junction with the Green River; of the Green River from Greenriver, Utah, to its junction with the Colorado River. (R. 139.) He filed a report of his investigation with his superior officers (Compl. Exhibits 75, 76, 77 and 78, R. 146.) His report is in no sense a partisan report. It is a technical report of conditions as he found them. (R. 143.)

He arrived at Greenriver, Utah, September 27, 1928, whereat the government maintains a gauging station. (R. 146–147.) The gauging station is maintained for the purpose of determining the daily flow, and from that, the monthly and yearly run-off of any stream at any point. The equipment consists of a gauge which formerly was a staff gauge but now, in general, is a record gauge from

which the heights of the river are obtained. In connection with the gauging station measurements are made of the discharge.

The discharge is measured by determining the width, the depth and the velocity. And knowing the width, depth, and the velocity the discharge in cubic feet per second is obtained. When that is referred to a gauge height some sort of relation is obtained from which the daily flow throughout the year is maintained. The Geological Survey maintains gauging stations on all the rivers of the country. (R. 147.) A recording instrument records the height of the water, the same as a temperature graph might record the temperature, through the twenty-four hours throughout the year. (R. 147–148.)

The depth of the water is obtained by an engineer from the local district office by means of soundings at the gauging stations. A gauging station is a fixed point on a river, generally on a certain stretch of the river, where it can be reached by the engineer at any time of the year; it should generally be near a habitation, where the gauges can be watched, and certain structures, either a cableway or a bridge, have been built, from which the flow measurements can be taken. The measurements of the depths can be made by soundings, and the measurements of the velocity are made with a current meter at the same time the soundings are made. It is a very technical operation to determine the flow of

the river; the operation is under the constant supervision of the District Engineer. At all gauging stations there is a local resident that generally winds the clock of the local gauge and sees that it is running and oiled, and he may possibly remove the record. Outside of that his functions stop, except to see that the gauge is in operation. The measurements of flow are made by a competent engineer from the district office. (R. 148–149.)

At the present time gauging stations are maintained at Cisco, Utah, about thirty miles upstream from Moab, Utah; Lees Ferry, Arizona; Grand Canyon and Topock, Arizona. These stations are on the Colorado River. (R. 149.)

The information which has been gathered on the flow of the Green and Colorado Rivers, so far as this case is concerned, was obtained at the Lees Ferry, *Greenriver,* and Cisco stations. (R. 149.)

The San Juan records give the best information available as to the flow at any time and are of interest in connection with the Colorado River in this way. For instance, the witness [Clyde L. Eddy], this morning was somewhat in doubt as to the stream flow during the flood; he had the gauge height at Lees Ferry. Now, if he was above San Juan, the San Juan record is needed to determine what the flow was above the San Juan; in order to get an idea it is necessary to determine the flow above the San Juan and substract that at Lees Ferry. It comes into the picture as the main tributary.

Compl. Exh. No. 79 is a series of hydrographs of the daily flow of the Green, Colorado, and the San Juan Rivers from 1901 to 1927. (R. 150.)

A second-foot, in ordinary river measurement of flow, means one cubic foot passes the point in one second. (R. 151.)

The sum of Greenriver Station and Cisco Station gives flow at the junction within reasonable limits, and the flow of these two and that of the San Juan at Bluff, is the combined flow of Colorado at Lees Ferry. (R. 151.)

From October to September is called a "water year." (R. 151-152.) Conditions supposed to be more normal each year beginning October each year. All stream records are computed as of that year, being a water year. (R. 151.)

Records at Greenriver Station show flow about 30,000 second-feet June 27, 1927, date of start of Eddy Expedition; dropped to 22,000 latter part of month; came up to 30,000, dropped to 23,000, up to 25,000, dropped off the normal drop during July and August. Maximum flow at Cisco around 43,000 second-feet; flow end of June approximately 70,000 second-feet in canyon above the San Juan in Cataract Canyon. (R. 152.) When these two rivers came together there was a peak flow somewhere around 70,000 second-feet. On or about July 1, 1927, peak flow at Lees Ferry during flood, was 119,000. Flood referred to in Mr. Eddy's testimony is indicated on map. (R. 152-153.)

Peak of floods appear almost simultaneously at any point on the stream; the peak at Greenriver and at Bluff, practically the same day, two days later at Lees Ferry. (R. 153.)

The day he started at Greenriver, Utah, flow was about 2,300 or 3,000 second-feet. Clyde L. Eddy had somewhere about 10 times as much water when he started. There is a very uniform flow from October to May—very low—in general lower than when he was there. A flow of 2,000, 3,000, or 4,000 second-feet on the Green River and the Colorado River is quite a large one.

The large run-off in May, June, and July is from melted snow; flow decreases until floods in August and September from thunderstorms. Thunderstorms rare during October and November, practically absent during December, January, and February.

So we have a condition where in a couple of months, or two and one-half months 70% of the water runs off, with the remainder of year low, except for frequent cloudbursts. (R. 154–155.)

In rivers with such a rapid run-off, peak might be fully one-half times more than some of ordinary peaks shown on these hydrographs. (R. 155.) Illustration: Saleratus Wash comes in South of Greenriver, Utah. It was dry the afternoon he arrived; thunderstorm came up at 10 o'clock that night, Saleratus Wash was out of its ten-foot banks,

flowing 10,000 second-feet by next morning. (R. 155.) Indicating changes you might have in dry wash immediately following a rain. (R. 156.)

Lees Ferry Gauging station had maximum flow of 180,000 second-feet in 1921. (R. 156.)

He thinks the same condition true of Colorado as of the Rio Grande, that the rises in May and June are due to snows, and those in August and September, to rains.

He started at Greenriver, Utah, with 16½ ft. boat with 4 ft. beam, 1½ ft. deep, equipped for use with an outboard motor. Draft loaded with two men in it, 12 or 15 inches of water. Trip started September 29, 1928.

Brown's Riffle was first bar he came to. Made survey of it. Boat taken down by boatman. They walked on shore. (R. 158.) Difference when compared with Army Engineer Corps survey of 1909, showed a widening of channel. (R. 158–159.) One object of investigation to determine how shifting the channel was and compared his survey with 1909 Army Engineer survey. (R. 159–160.) Plate 4, shows comparative surveys. (R. 159.)

His examination of the physical channel included also the question whether it was a permanent river channel, whether it was shifting—its physical characteristics. To determine that he used these surveys as a comparison. He found it was shifting.

The next bar was the Mohre bar and riffle, ¾ mile downstream from Greenriver. In comparison with

1909 Army Survey it shows radically different conditions. (R. 161.) In 1909 the channel was split in two by an island; there were two channels, one on each side. On October 1, 1928, the flow was confined in a single channel. (R. 161, Plate 7.)

The next bar is the Two Mile bar and riffle, 1½ miles below Greenriver. (Plate 6.) Comparison with Army 1909 Survey is shown on Plate 9, conditions are very nearly the same. (R. 162.)

The next bar is Butterfly bar and riffle, 1½ to 2 miles below Greenriver. (Plate 10.) Comparison with Army 1909 Survey is shown on Plate 11. Reduction in size of island; west channel has widened materially; east channel has widened materially. (R. 165.)

The next bar is the Auger, 4½ mi. below Greenriver. (Plate 12, Compl. Exh. 76.) This Bar is formed by debris brought into Little Grand Wash. Fall of about 3½ ft. at the riffle. Maintained its outline of 1909. (R. 163–164.)

The next bar is the Farrer bar and riffle, 5 miles below Greenriver. (Plate 15.) It is a so-called crossing bar, and it has maintained its same relative position.

A crossing bar is a bar which builds itself up in a river, generally in straight stretches of the river, between bends; it is formed by deposit of silt and sediment, extends from one bank to the other diagonally; it may be 1,000 to 3,000 ft. long, as compared with a river of 400 or 500 ft. in width. (R. 164.)

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The river is confined in general between rock walls, river limited by its rock walls. (R. 165.)

These crossing bars are peculiar to stretch above the San Rafael.

The Cable bar and riffle (Plate 16); Army Eng'rs. survey makes no reference to it, apparently not there then; it is located 109.9 miles above the mouth of the Green River.

The next bar is also a crossing bar, 109 mi. above mouth of Green. (Plate 17, Compl. Exh. 76.) No comparison. An independent survey. (R. 166.)

The next bar is the Halverson bar and riffle, 108½ miles above mouth of the Green River. Very little change when compared with 1909 Army Engineer Survey. (R. 166–167.)

The next bar is at 106.7 miles above mouth of Green River. It has formed since 1909. It has a drop of 2½ ft. (R. 167.)

The next bar is the Gimlet bar and riffle, mile 106 above mouth of Green River. Probably bar referred to by Mr. Eddy, as being at right-angle turn in current and waves. 75% of flow comes between two islands and goes directly into rock talus bank on west, turns, and then comes down into channel. Conditions the same as in 1909. (Plate 22.) (R. 167.)

Sunaba bar and riffle, Mile 104. (Plate 23.) It was not in place in 1909. It has a 3 ft. drop. Channel depths, 1 to 3 ft., with numerous submerged rocks. (R. 167–168. R. 169.)

The Second Anvil bar, Mile 101.5 above mouth of Green, is practically same as 1909 survey. (R. 168.)

The First Anvil bar and riffle, 100 miles above mouth of the Green River and on Plate 26, comparison is made with 1909 survey. Conditions at the mouth of the San Rafael (The San Rafael Bar), 94.9 miles above mouth of the Green River: This bar is compared with the 1909 survey on Plate 29. The bar is formed by sediment from the San Rafael River. One of the most shifting bars in river. (R. 169.) Marked difference between March 2nd and October 6, 1928. Constantly shifting bar. (R. 169.) This completes the list of bars and riffles to point 94 miles above the mouth of the Green River and 21 miles below the town of Greenriver, Utah. The last riffle is where the line between Township 23 and 24 south crosses the river.

He went down to the mouth of the Green River in light rowboat which had come to Greenriver, Utah, overland from Salt Lake City. (R. 175.)

A large motor boat had been shipped from Moab to Greenriver overland for use below mouth of the San Rafael River. It was 24½ ft. long, 6 ft. beam at stern, 2½ ft. deep, equipped with Chandler 6-cylinder motor and a fixed propeller. It required a draft of 2½ feet without the propeller striking bottom. (R. 176.)

After examining the Green River from Greenriver, Utah, to the mouth of San Rafael, he decided this large motor boat loaded with draft of 2½ ft.

could not be taken down the river to the mouth of the San Rafael River. So then went back overland to Greenriver. (R. 177.)

He did not have this boat brought down Colorado River from Moab to junction of Colorado and Green River and then up the Green River to Greenriver, Utah, because it was a question of whether they could get the motor boat upstream on the Green River at that stage of water.

He walked from mouth of San Rafael to Greenriver, Utah, 24 or 25 miles. The country is not irrigated or susceptible of irrigation; it is rough, broken, absolutely barren rocky soil, desert country. (R. 178.)

He, together with Mr. Baldwin, principal operator of Moab Gorge boats, decided that they could not launch the large motor boat at Greenriver; so went down to near Wimmer's Ranch by automobile. Wimmer's Ranch is across from the mouth of the San Rafael River. No signs of any one living there; house has fallen in; one improved ranch on east side of river. (R. 178–179–180.) It is all desert country. (R. 180.) On the east side of river road is away back; it is an entirely barren desert country, more or less rolling, hilly, and broken with washes.

Compl. Exh. No. 77, presents complete pictorial history of Green and Colorado Rivers between Greenriver and Moab. (R. 180.)

Found could not launch boat on east side of river under any conditions; went back to Greenriver;

then took 5-ton truck, the motor boat and the canoe and went down west side of river to point on San Rafael River 3 miles above where it empties into Green River on the west side. (R. 180–181.)

There is a ranch at Greenriver; south of there no signs of habitation along road or any irrigated tract. Shack at ranch at mouth of San Rafael; possibly grazing headquarters. (R. 181.)

He went along north bank of San Rafael River for quarter of mile, got stuck in sand; impossible to launch motor boat at any point. (R. 182.)

Decided to take canoe; canvas covered, 15½ ft. long, 4 ft. beam, equipped with oars, special safety device flange.

Put canoe in San Rafael River with supplies and five men; tried to drag it down to the river. Some places plenty of water, some places half an inch. Put half supplies on bank and tried to drag canoe with other half; took all supplies out and dragged empty canoe down San Rafael until got to its mouth.

Took canoe and a rowboat and started down the Green River. Sent Virgil Baldwin with truck back to Greenriver, arranging to have him meet them at junction of Green and Colorado Rivers with outboard motor boat, gasoline, and extra supplies. (R. 183.)

Mr. Blake, an expert boatman, handled the row boat. Below mouth of San Rafael, there is to all practical purposes a uniform slope of between one and two feet to the mile; no riffles, no rapids, no

breaks in the general surface of the water. River enters the canyon about two miles below, and flows continuously in the two canyons named by Major Powell. The river channel meanders on last stretch between rock walls, with alternating sand-bars on each side of river; with crossing bars between all of the straight stretches. Bed of channel is sand and silt deposited on account of slack water; the channel wanders and meanders between those bars. Surveyed three or four of larger typical sidebars in order to get idea of their characteristics, how permanent, how they cut and washed; took photographs and soundings. (R. 184.) With small boats no great trouble on bars, because if got on bar would push off. (R. 184.)

Encountered sand bars continuously through that strip. Crossing bars can be called such or shoals where depth runs from one inch to half a foot. (R. 185.) That generally was the condition, a gentle, slow-moving stream, so that might make a mile or two miles an hour upstream by rowing, the velocity being two or three miles an hour. Can make progress upstream with effort, one or two miles an hour, as he could judge where they would have to drift down past the bar and then try to row back to the bar.

Channel in no sense permanent, except here and there, going around a curve the outer edge of the flood channel where water abuts against rocky slope or rock wall, in a sense that it would be a fixed, permanent place. (R. 185.)

A far greater percentage of mileage is against earth banks, the bars really, and benches have been formed, now changing, filling in by floods and washing out. (R. 185–186.)

Because of known amount of débris and sediment brought in and deposited, he would say it would be impossible to maintain for any length of time any sort of permanent channel. Bottom just soft silt; can push rod down 8 or 10 feet with tip of finger; can not walk on it in places; can not pole it; boat stuck so would have to hang on to boat, would sink, have no purchase. Some of bars are of harder sand. But in many cases just sunk down. Bottom so soft by moving around in boat the current would strike it and gradually worm it off. (R. 186.)

Below the mouth of the San Rafael the river bed constantly changing. (R. 187.)

Photo 42 (Compl. Exh. 77), mile 84.4 shows bar 3,500 ft. long in bend of river. River barely below the surface. Any small rise washes top of the bar; the edge constantly being cut and swept into river. Above that a higher bar, elevation from three to five feet. (Compl. Exh. 76.) (R. 187–188.) Plate 33–A is cross section of bar at mile 80.5 (R. 188.) Plate 31 are typical conditions at bar; river in bend to right; outer part of current follows vertical rock wall.

On inside are the three bars abutting against the mass of talus which forms extreme flood channel on right bank. 200 ft. of the bar is practically a wash; each slight change in river washes the sur-

face and cuts into the vertical slopes of second bar; a rise of 6 ft. floods the second bar, changes its surface, and cuts against the third bar; extraordinary flood, 13 to 14 ft. at that point would fill entire channel between the rock walls, and tend to wash out all of the bar at that place, depending on size of flood.

Crossing bars which are known to change are caused by the washing away of sand and soil on these crossing bars, which is carried down stream to where river changes into a straight channel, where they are deposited and then build, and then change on account of silt and sediment from these bars as well as from silt and sediment brought in from main stream. (R. 188–189.)

Plate 33–A is typical of numerous places between the mouth of the San Rafael and the junction of Green and Colorado Rivers. (R. 189.)

The bars below the mouth of the San Rafael at mile 84.5, mile 80.5, mile 72.2, mile 23.24, were surveyed in order to show typical bar conditions along the Green River. This done to study how permanent channel might be. They are all given a name, the photographs showing the different bars included therein. (R. 189–190.)

Plate 30 is typical. It shows wandering of channel between rock walls; it shows alternate bars as river swings from side to side; it shows on curves, the outer portion is against the talus; how on the inside of bars there are invariably these bars and willow-covered benches. Experienced floods while south of San Rafael.

Plate 2 of Appendix C of Compl. Exh. 76 is a hydrograph of the flood at Greenriver during September and October, 1928, and for comparison the hydrograph of daily flow September and October, 1925, which was an exceptionally high period of run-off. Also September and October, 1924, which was an extremely low run-off. (R. 190–191.)

On September 27 the mean flow was 2,830 sec.-ft. On the 28th the mean flow was 4,000 sec.-ft. That night the flood reached 6,000 sec.-ft. October 4, the flood reached 16,400 sec.-ft. Oct. 15 the flood reached a peak of 16,000 sec.-ft., and on Oct. 31 there was a peak flood of 7,980 sec.-ft. (R. 191.) He experienced flood of Oct. 14 and 15. (R. 190–191.) Was in the canyon below mouth of San Rafael, surveying bar at mile 80.5, and survey not completed, and next morning large portion of bar was submerged: Dots on Plate No. 31, Compl. Exh. 76, show where bar was afternoon of flood. (R. 191.)

Silt is measured by taking samples of water, either by volume method or by per cent by weight method, the latter method is now the practice in the survey. (R. 192–193.)

Report (Compl. Exh. 75) of calculations of amount of silt carried annually in Green River are based on scientific investigation. (R. 193.)

As shown on page 78 of his report, Bulletin No. 67, Dept. of Agriculture, entitled "Silt in the Colorado River," indicates between 10,000,000 and 30,000,000 cubic yards of sediment are carried an-

nually into canyon at Greenriver. (R. 193.) This is measured at Greenriver. (R. 194.)

There is a constant deposit of silt in river at Greenriver, and a redistribution and assorting of silt and sediment brought in at the San Rafael and other side washes; the fact that tributaries bring in debris is shown by bar formations surveyed at mouth of washes. (R. 194.) Falling in of banks of sandbars also contributes to silt in suspension.

The wind contributes to some extent to sediment in river. Photograph No. 40–A, Compl. Exh. 77, is snap of sandstorm blowing up river; it was so strong could not row against it in boats; so had to camp. (R. 194.)

Big boat with 2½-ft. draft, which was brought overland from Moab to Greenriver for use in connection with examination of rivers, in his opinion could not have been brought by water upstream from mouth of Green River to Greenriver, Utah. (R. 194–195.) The boat was returned overland to Moab, and later met them at the junction. (R. 195.) Plates in Compl. Exh. No. 10 show Green River, between mouth of San Rafael and its junction with Colorado, to be winding and tortuous throughout. (R. 195.) Approximately straight for mile between miles 7 and 8. Practically straight between miles 35 and 37. Characteristics of a straight river between miles 27 and 29. (R. 195–196.) Benito Bend (Plate 33, Compl. Exh. 10), distance around curve approximately 7 miles; about a quarter of a mile across the neck. (R. 196.)

On Plates in Compl. Exh. No. 10, he has shown in red ink by number and initials, all photographs made and referred to in Compl. Exh. 77. He has also shown thereon by means of red arrows the location and number and volume number of all photographs in files of the Geological Survey made by various engineers who have traversed the rivers. (R. 197.) Sheets in Compl. Exh. No. 77; the numbers in circle indicate mileage above mouth of river. In Compl. Exh. No. 78 is shown in red location of side bars and crossing bars. (R. 197.) Plate 3, Compl. Exh. 76, the dash line shows approximate channel conditions of river as shown by General Land Office survey dated June 6, 1883. River surveys U. S. Reclamation Service, are part of river survey sheets made in 1914, and are shown by solid black line. This Plate was drawn to show typical channel conditions above Greenriver, where river flows over plain between Book Cliffs and town of Greenriver. (R. 197–198.)

East Blake was in southwest corner of Sec. 10, plat of June 6, 1883. In 1928, main channel of the river flowed across the east half of Sec. 10, and what was the location of East Blake is now half mile west of river. (R. 197–198.) This plat is an official Government map made from actual survey, April 6, 1883. (R. 199–200.)

Compl. Exh. 75, pages 20–23, shows in detail different conditions and changes in river between Greenriver and Book Cliffs. (R. 199–200.)

He was met at mouth of Green River by Virgil Baldwin, and assistant, in rowboat. Ran down and camped two miles below the junction. (R. 200–201.)

On Compl. Exh. 10, he has indicated by red arrow the location, volume number, photograph number of all official photographs in files of U. S. Geological Survey throughout the rivers. (R. 201.) Also he has given the location and number of rapids which are shown in red. (R. 201–202.) The location where slope indicates rapid water is shown in green; and where slope is such that flow might be termed quiet or smooth water left in white. (R. 202.) The location of the rapids is correct. The green stretches are placed where the slope is such that during a low water stage it is rapid water. The stage changes in the river; certain stretches of quiet water, may be rapid water, or may become rapids. Conditions shown on map are ordinary low-water conditions of river. (R. 204.) The profiles themselves are the basis from which all the information is obtained. (R. 205.)

The records of the Interior Dept. disclose certain rapids in Cataract Canyon; the number of the cataracts are fixed by official survey, but one person going through might count a larger number than another. (R. 205–206.) There are smaller ones. (R. 206.)

Between mile 204 and mile 205, is probably the rapids Mr. Eddy referred to as one continuous

rapid. The topographers who went through when they surveyed those rapids found five rapids and numbered them from 1 to 18, but they were continuous one after the other. (R. 207.) The elevation is shown on profile maps in 5 ft. drops. (R. 207.)

The party then proceeded back and up the Colorado River from the Cataracts. (R. 209.)

Photographs 127 and 66, Compl. Exh. 77, are views taken at the Slide, 1.8 miles above junction of Green and Colorado Rivers. Plate No. 34 is a plane table survey of the Slide. (R. 210.) The Channel there at medium low water is approximately 100 ft. across. Very material velocity increase over what it is upstream or downstream. (R. 210.)

Mr. Baldwin operated motor boat that came down from Moab with three men and supplies in the boat. He and Mr. Blake operated the small row boat with the outboard motor.

The large motor boat towed the canoe, and it had a gear shift; could stop the engine from stalling by putting it in low and get more power. (R. 211.)

The small boat ran on sand bar just above Slide. (R. 212.) The other boat turned to right, and skipped the bar, knowing it was there. (R. 212.)

Left camp at 8.37 a. m. October 19. The big boat stuck on sand bar at mile 3.8; Mr. Baldwin was trying to find a channel over the bar; he had been

over that stretch Wednesday of that week. (R. 214.) Small boat with outboard motor stuck several times at the bar at mile 3.8 at mouth of Salt Wash.

For about 4½ miles 66% of time traversed that morning, the river was bending, channel followed outside of bend. Not necessary to take soundings around bends. When river straightened out between bends, it was the practice to take soundings. Crossing bars between miles 4 and 5, and between miles 7 and 8. Course followed by boats is shown on Plates 17, 18, Compl. Exh. 10, by dotted black lines. (R. 214–217.) Red circle with dot shows where large motor boat was stuck and required pushing to get off bar. (R. 213–214.) Small red cross shows location of places the small boat with outboard motor stuck and required lifting of motor or some operation to get boat off. (R. 215.)

This was his first trip. Average speed upstream including all stops, 1.8 miles an hour. (R. 215.)

From mile 10 to mile 13.5; channel alternated from side to side, depending on character of bends.

At mile 15.8 river made decided bend to left; decided whirlpool on account of bend. Special survey made. (Plate 36, Compl. Exh. 76.) Photographs also taken. (R. 215–216.)

At mile 15.8 very decided sand bars were noticed; there were crossing bars at mile 16.8, mile 19.5, mile 20.9. Between mile 19 and 20, both boats had considerable difficulty. Larger boat stuck at

least twice. Small boat went on ahead many times to locate channel; he only shows the times he actually observed big boat was stuck; course of river to mile 20, winding between rock channels, alternating side bars, with crossing bars between the bends, and almost invariably the crossing bars gave trouble with operation of boat. (R. 215–216.)

At mile 18.4 the large boat stuck; it stuck twice between miles 19 and 20. (R. 216.)

Plate 18, Compl. Exh. 10, shows course of river from mile 21.5 to point above oil operations through to mile 50 above the Green River. (R. 217.)

Trouble at mile 18.3 was channel was not against bank where ordinarily it should have been; trouble at miles 19.4 and 19.6 was result of the crossing bar. Reached mile 22, noon Sunday, October 20th. At mile 22, ran into crossing bar and a side bar, formed by deposit of material washed in from right. Big boat got stuck at that point. Plowed its way through, bed of river so soft that increased current at side of boat tends to form a channel, so that if it stays there long enough it will form a channel. Between miles 22 and 23 and 24, there is a large sand bar; it is shown in river survey of 1912; it is now grown with willows and is 12 ft. above river. Did not run into that. (R. 217–218.)

At mile 25.8, both boats made wide detour to avoid what Mr. Baldwin claimed were rocks in river.

Between mile 24 and 26, had considerable trouble finding a channel. Rock walls much wider there;

there is increase in size and extent of exposed bars there. (R. 218.) Where rock walls miles apart and channel widens out, it is naturally shallower and more exposed bars are there; making it more difficult to find channel. At mile 24½, are crossing bars upon which both boats had trouble. (R. 218.) Between miles 25 and 26, next to outer rock wall, where channel supposed to be generally, there is a large exposed bar necessitating both boats going into the inner bank; this illustrates channel will not follow ordinary custom but will leave outer bank. (R. 218–219.) Found such idiosyncracies that often in Green as in the Colorado River. (R. 219.) That is ordinarily so as to any river.

At mile 27, mouth of Lockhart Canyon, channel has been forced against the right bank; then swings to left bank, just below mile 28. At mile 28.3, there is a decided crossing bar; channel sufficient to float both boats; between miles 20 and 30, there were crossing bars, at which both boats got stuck.

In general it was much easier for the small boat to get off, because simply lifted propeller and used oar to push off.

October 21, camp at mile 30.7; upstream from mile 31, around bend, big boat got stuck at mile 31.2 on crossing bar. At mile 32, channel was well defined.

Immediately above mile 32, between miles 33 and 34, there is fairly straight stretch of river; and then ran into most difficult crossing bars had thus

far encountered; it took half an hour for getting both boats across that bar; big boat put its motor in low and plowed through. (R. 219–220.) Depths at outside bends more or less uniform; say three to four feet. (R. 220.) That ruling depth in channels where they lie next to the outside.

The flow is generally lower during November, December, January, and February, than during October. (R. 220.) Flow less September to April. (R. 220–221.)

While he was in there the mean flow of the Colorado River was 3,900 second-feet. (R. 225, 235.) A study of the stream-flow records shows that on an average, 205 days in each year, the flow is less than that amount. (R. 221.)

On average there have been 22 days in October, 29 days in November, 31 days in December, 30 days in January, 27 days in February, 27 days in March, 3 days in April, 1 day in July, 15 days in August, and 21 days in September when flow was less than that amount. (R. 221.)

For two-thirds of the year the Colorado River has a flow less than when he was there, and a third of the year a flow larger than that amount. Probably one-half less during the months of December, January, and February. (R. 222.)

His trip not made at abnormal time of year. More water when he was there than there is ordinarily in October. (R. 223.)

Plate 28, Compl. Exh. 79, is a compilation of over 30,000 daily observations at gauging stations on Colorado, Green, and San Juan Rivers; it shows by dot and dash the daily deficiency curve based on all data collected by Geological Survey at the Cisco Station on the Colorado River; it shows extreme low water October flow is about 2,000 second-feet; extreme high October flow is 14,000 second-feet.

On the average, in October, the flow has been 5 days below 2,500 second-feet; 5 days between 2,500 and 3,500 second-feet; 5 days between 3,500 and 4,000 second-feet; 5 days between 5,000 and 14,000 second-feet. (R. 224–225.)

He was on the Colorado River between October 18 and October 25; flow was, on October 18, 4,520 sec.-ft.; October 19, 4,300 sec.-ft.; October 20, 4,090 sec.-ft.; October 21, 3,920 sec.-ft.; October 22, 3,770 sec.-ft.; October 23, 3,650 sec.-ft.; October 24, 3,690 sec.-ft. (R. 225); giving about 3 ft. in the channels around the bends, and in the broad, straight stretches, between the bends, between one and two feet. Between the bends, or at points approaching crossing bar, the depths are 1 to 1½ to 2 ft. in channel, at the bars where the boats were stuck. Compl. Exh. 79 gives graphic sketch of conditions of water there. (R. 224, 225–226.)

In 1923 the flow generally was equal or less than 4,000 sec.-ft. for a large part of October.

At miles 35 and 36, extremely careful with boats because Mr. Baldwin reported submerged rocks at which at least one motor boat had been wrecked.

Especially troublesome crossing bars were encountered at miles 40.4, 43, and 46.5. Both boats stuck at mile 46.3 and motor boat at mile 43.7. (R. 227.) Motor boat stuck twice at miles 43.6 and 43.3 and the small boat once. (R. 227.)

Mr. Baldwin took continuous soundings in the 16 miles traveled on October 21, and when the depth became less than three feet he knew he was approaching a crossing bar and started looking for deep water if it could be found. (R. 228.)

Monday morning, October 22, he stopped at mile 48½ on right bank (John L. Shafer well No. 1–A); the channel between miles 47 and 48½ was extremely difficult to find, especially in the vicinity of the John L. Shafer well No. 1–A; leaving there the channel crosses to left bank at mile 49.2, where there is an extensive crossing bar. It crosses back again at mile 49.7, where there is also an extensive crossing bar. (R. 228.)

Between miles 50 and 51 the channel was more or less indefinite. A very decided crossing bar was at mile 50.2, where both boats had lots of trouble; they were half hour working their way across. Not up to Moab yet. (R. 228–229.)

From mile 50 to boat dock, just above mile 65, ran into crossing bars almost continuously. Outstanding crossing bars were at miles 53.9, 54.5, 55.4, 55.9, 56.5, 59.2; and shoals and shallow places are scattered on both sides of the river, clogging the channel on Mill Creek side and below Courthouse

Wash and in a long straight stretch by Kings Bottom, mile 60 to 61.

The large motor boat stuck at miles 53.8, 54.5, 55.9, 56.7, 61.1, and 64.8, the mouth of Courthouse Wash ¼ mile below the dock. (R. 229.) No trouble at mouth of Mill Creek. Mr. Baldwin stated they very often had trouble there due to sediment brought on by Mill Creek. (R. 229.)

Between Moab and junction of Green and Colorado Rivers and on the Colorado River he did not notice any land which in his opinion was subject to irrigation. Mill Creek is really Moab and the end of Moab Valley and he observed no land between that point and junction of Green and Colorado that seemed capable of agricultural use. The boat dock is within two miles of Moab. (R. 231.)

There are two or three places, with possibly total acreage 500 acres between mouth of San Rafael and mouth of Green River, surface sufficiently above high-water flood, might be irrigated and farmed, in the entire stretch of 89 or 90 miles. (R. 231–232.)

He continued his examination of the Colorado River from Courthouse Wash to Castle Creek by following the secondary highway, that runs along the east bank of Colorado River, by automobile from Courthouse Wash to Castle Creek. He surveyed the stretch of river from miles 70.9 to 72. The survey is shown on Plate 37 of Compl. Exh. 76. The river changes materially. It takes on the

characteristics of a mountain stream; the rapids being numerous, large rocks exposed in the channel. The bed no longer is silt and sand. A great deal of débris is brought down into the river from each side wash which has formed rapids. (R. 232.) Such conditions obtain from near the mouth of Sheep Creek, mile 68, about 3 miles above bridge at Moab.

Between mile 68 and mouth of Castle Creek, mile 79, the river is much deeper than down below. The rapids are all in heavy gravel and rock boulders, with a fall of one to four feet. There is no longer any quiet water. Upstream progress with a boat is naturally limited by rapids you hit there, beginning at about Sheep Creek and running upstream. (R. 233.)

On the Colorado River between mouth of Green and Moab, the same conditions of instability obtain there as on the Green River.

Approaching Castle Creek conditions are more of a mountain stream. (R. 233.)

Characteristics of the two streams are very nearly the same. More crossing bars were observed on Colorado than on the Green. (R. 234.) The Colorado is straighter between junction and Moab.

The windings of the river account for the crossing bar conditions; the crossing bar forms wherever the current crosses from one side of the river to the other. (R. 234.)

The Colorado carries more sediment which may account for presence of more crossing bars.

Report prepared by him Compl. Exh. No. 80, W. G. Hoyt, entitled "Rapids, Rapid Water, and Quiet Water," is a compilation of all the representations of all the rivers as shown by the published profile maps of the Geological Survey. (R. 235–240.) The rapids were numbered by the topographers and they have been carried through by various writers. (R. 238.) Freeman in his book uses the same numbers. The number is not shown on the printed report of the Survey, because they show nothing but the plan, profile, and contours. The location of the rapids on the map is shown by a blue symbol.

The map indicates the location of Rapids No. 1, with respect to miles above Lees Ferry. It shows its length, its fall in feet, and there was 25 ft. of fall to the mile at that particular place. This is shown by means of computation from the maps. (R. 239.) In paragraph A, Compl. Exh. 80, he defines rapids, rapid water, and quiet water. (R. 241.) He has used the word "head" in the report in the same way you speak of head of a dam, it is the difference in elevation above and below the riffles. A "head" of 3 ft. in a distance of 1,000 ft. means the profiles or surveys show there was an actual fall of 3 feet in a distance of 1,000 feet.

In the study of river flows, where, for instance, a rise of two feet is indicated on the gauge, that will

not necessarily produce a two-foot depth of water on riffles and sandbars. On account of the changes in slope of a river, and changes of width at different places, a rise of two feet at any one place did not necessarily mean that there would be a two-foot rise at any other place. Given the same hydraulic conditions, the same cross section, and the same slope at another cross section, there would probably be the same two-foot rise. But if you increase your width, or change your slope, you change the height to which the water will go.

The amount of silt or sediment carried or transported by a river, depends largely on velocity. If velocity at riffles is high enough to send forth all of the finer silt and sediment, which when water reaches quieter stretches they are deposited in the quieter stretches and remain there until velocities increase during flood periods and carry them to some other place.

He has studied official reports of experiments made on Colorado River and character of material in Colorado River varies from fine sediment to gravel like that carried in the San Juan; it varies at different periods of the year depending on floods from the higher portions of the river in snow; or from lower stretches of the river from rains, etc., changes character of silt. (R. 242–243.)

Compl. Exh. No. 81, "The Colorado River" by Lewis R. Freeman. (R. 243–245.) It is descriptive of the Colorado River, considered authori-

tative, but not scientific; historical and remarkable book of Cataract Canyon and river as a whole. (R. 244.) Mr. Freeman obtained enough knowledge of river to write book from accompanying survey parties as boatman or helper.

Compl. Exh. No. 82 "Characteristics of the Colorado, Green, and San Juan Rivers, as Shown by Current Meter Measurements," by W. G. Hoyt. (R. 246–248.) It is a compilation of data at base gauging stations, which show certain things. The meat of the report is in the Plates. He makes no conclusions. The plates show all the information, Plates 1–A, to 6–A, and Nos. 1 to 13. (R. 247–248.)

Compl. Exh. No. 83, is a comparison of slopes of the Colorado and San Juan Rivers, with other principal rivers of United States, prepared by W. G. Hoyt. (R. 249.)

Compl. Exh. No. 85, is a brief description of the Colorado, Green, and San Juan Rivers and tributaries, prepared by W. G. Hoyt. (R. 249–250.)

After completing his examination of Colorado River he proceeded to and then made an investigation and survey of the physical characteristics of San Juan River at point where the river crosses the State line between Colorado and Utah; going there overland by automobile. (R. 250.)

The result of his investigation and survey is in his report of examination at State line of San Juan River, in Compl. Exh. No. 86, together with photos accompanying report, Compl. Exh. No. 87.

Compl. Exh. No. 88, is a compilation of stream flow characteristics of several rivers at base gauging stations. (R. 255, 260.) These tables show the yearly run-off; mean monthly run-off; minimum days for each month; maximum run-off for each month; for all of the years. Then there are deficiency tables showing the number of days of each month the flow has been less or more than certain amounts. (R. 256.) Fully nine-tenths of all the figures given are based on official figures; a compilation of high, low, stream flow records, arranged by months, years, and stations. (R. 256–257.) It is a computation showing the discharge in second-feet throughout the year compared with the mean annual discharges (R. 257–258), and are the daily mean maximums, minimums, and variations of discharge of each station (R. 259–260).

For instance he shows in the report the mean annual discharge of the Colorado River at Lees Ferry, at page 39, for the years 1922 and 1928 what the mean annual discharge has been, what the mean annual run-off has been, what the minimum day has been, what the maximum day has been, and how the discharge has varied throughout the period. For instance, in 1925 the mean run-off was only 58 per cent of the normal. In 1922 it was 16 per cent above normal. In other words, that is just a method of computation to show what the discharge was throughout that year compared with the mean. (R. 257–258.) Where any variations are referred to by him the figures that he gives indicate that

these variations are always the figures of gaugings at the same station. (R. 258.) When he wrote his report on the Green and Colorado Rivers he compared the run-off at certain points on those streams, to show which was the largest, and he showed that the maximum during certain months of the year was large on the Colorado River and certain months on the Green River, but nothing of that is in this report. This report is a study of the gauging station records for each station. Each page of it refers to one particular station. (R. 259.) There is nothing selected in any of those tables.

Compl. Exh. No. 89 is the record of stream flow at Cisco, Utah. (R. 260.) Compl. Exh. No. 90 is the record of stream flow, Lees Ferry, Arizona. (R. 260–261.) Compl. Exh. No. 90½ is the record of stream flow, Bright Angel Creek, Arizona. (R. 261–262.) Compl. Exh. No. 91 is the record of the stream flow at Topock, Arizona. R. 262–263.) Compl. Exh. No. 92 is the record of the stream flow at Yuma, Arizona. (R. 263.) Compl. Exh. 93 is the record of the stream flow at Greenriver, Wyoming. (R. 263.) Compl. Exh. No. 94 is the record of the stream flow at Greenriver, Utah. (R. 263.) Compl. Exh. No. 95 is the stream-flow chart at Shiprock, New Mexico. (R. 263.) Compl. Exh. No. 96 is the stream-flow record at Bluff, Utah. (R. 263.) Compl. Exh. No. 97 is hydrographs of the Green River, at Greenriver, Utah, prepared by W. G. Hoyt. (R. 263.) A hydrograph is a graph showing the daily discharge of the stream—it is a pictorial graph. (R. 263.) Compl. Exh. No. 98

is a summary of the stream flow of the Green River, at Greenriver, Utah, and the Colorado River, at Cisco, Utah, prepared by W. G. Hoyt. (R. 264.)

He saw no boats, no signs of habitation between the mouth of the San Rafael and the Cataracts. (R. 268–269.) In his trip up the Colorado River, he did not see any homes, ranches or other signs of habitation, outside of shanties at oil wells. (R. 269.)

Cross-examination (R., Vol. 2, pp. 271–345):

Arrived Greenriver, Thursday, September 27; left following Monday for mouth of San Rafael. Took a week to make examination of river to that point; after examination decided not to use the large boat which was brought overland from Moab to Greenriver. (R. 273–274.) Had never seen river before. (R. 272.)

Government Evinrude boat with outboard motor was used on trip and was taken by him from Greenriver down the river, clear around. It was 16 ft. long. (R. 276.) This boat is shown on photographs 10 and 12. [Compl. Exh. 77.] The large boat he had intended to use met him at confluence of Green and Colorado Rivers; canoe, rowboat, and motor boat used by party between the confluence and Moab. (R. 277.)

He did not have in mind as one of the purposes of his report (Compl. Exh. 75) the question of the navigability of the Green and Colorado Rivers, nor the question of whether boats of various sizes could descend the river. He hoped he would not be a witness in this case, but thought he probably

would be, but was not absolutely sure. (R. 278–279.) He has never been a witness in any matters. (R. 280.)

First real difficulty was at the Slide, ran on a sandbar just above. (R. 281.) Big boat stuck at mile 3.8 upstream from the confluence. Struck several bars just below mouth of Salt Wash. Big boat struck one through that area. (R. 282.)

Small boat ahead most of time because drew less water; probably ahead 90% of the time. (R. 282.)

Big boat stuck at mile 7.8 and when they got to the 15-mile point, and from there upstream at miles 16.8, 19.5, and 20.9 encountered some bars. Again at point 21.5 and to point 50, continuously struck bars. (R. 283.)

Crossing bars were especially troublesome at miles 40.4, 43, and vicinity of mile 46.5. (R. 283–284.)

Had great difficulty finding channel between Shafer No. 1 camp and John R. Shafer No. 1 well; no more than at any other place on Colorado. (R. 284–285.) The same ordinary conditions they had on the preceding day up to Frank Shafer No. 1 camp.

Came upon big bar at mile 49, 50.4 and continuously with alternate bar and channel to the boat dock at mile 65. (R. 284–285.) It is 65 miles from junction to Moab.

Had very much more trouble with bars on Colorado than on the Green; more difficulty in navigating, due to the type of boat; had same boats on Colorado as on Green, plus one other boat. (R. 285.)

Stuck much more frequently with boats with which they had on trip from Greenriver to junction and up the Colorado, than with the large boat that came down from Moab to junction to meet them. (R. 285–286.) Boat used to junction did not have motor on down to junction on Green, and had therefore a foot less draft. (R. 286–287.) The boat with the motor had a swinging propeller that tripped up with reference to meeting any obstructions.

There were a great many more sand bars in the Colorado than in the Green, meaning bars that come to or near the surface and that must be avoided in navigating the river. There are more crossing bars on the Colorado that may impede progress than on the Green River. The Colorado in general has the biggest flow of water. (R. 287–288.)

According to the official records (R. 289), the comparative flow at the Greenriver, Utah, and Cisco gauging *stations*, is as follows:

Date	Green-river, Utah, flow in second-feet	Cisco, Utah, flow in second-feet	Date	Green-river, Utah, flow in second-feet	Cisco, Utah, flow in second-feet
Oct. 1, 1928	1,930	3,060	Oct. 7, 1928	1,570	2,830
Oct. 2, 1928	1,680	3,030	Oct. 14, 1928	3,570	13,200
Oct. 3, 1928	1,590	2,920	Oct. 20, 1928	5,120	3,920
Oct. 5, 1928	1,540	2,830	Oct. 21, 1928	4,410	3,770
Oct. 6, 1928	1,550	2,810	R. 289-290-291.		

On October 12th there was a discharge of 12,000 second-feet at Greenriver, Utah. That peak showed up at Cisco on the 14th.

The discharge in each stream was not uniform; the flow was variable from 3,920 up to 13,200 second-feet. (R. 292.) Based on all records the Colorado is larger. (R. 292.)

The Green River was the lowest from October 1st to the 12th, and in coming down the Green they rowed a large part of the way; they had no motors; the canoe was towed up the Colorado River. (R. 294.)

Comparing the two rivers the impediments were substantially the same on both rivers between the mouth of the San Rafael and Moab. It was as easy to go up, or to go down, the one river as the other in a boat of the character he used. (R. 294.)

The San Rafael at the time of the year he was there is a very small stream. a long stream with little run-off; not enough water to float an empty canoe. (R. 295.)

No mention is made in his report of navigation, except as defining the bed of the river. It was not a navigation report in any sense of the word. (R. 295.)

Mile 68 is the upstream limit for type of boats used below Moab. He is discussing physical characteristics of the river channel in his report when he refers to impediments.

His report will probably be published as a technical report on the characteristics of the river. (R. 298.) He is not a navigation expert. His report is a technical report as to the characteristics of the

river and river bed. Between mouth of San Rafael and Moab with same boats, loaded in the same way, propelled in the same way, would have about the same type of sailing, and would encounter about the same difficulties. (R. 300.)

He knows that between the mouth of the San Rafael and Greenriver the river is more difficult. He had never been over that part of the stream before. He knows of no pitfalls. He would go down that part of the river the same way if he had to make another examination. (R. 301.) There was no difficulty in finding the channel, and he was sure that he found it at all times and if he had been more familiar with the river it would have made no difference because the man handling the boat is considered one of the best river boatmen in the Colorado River Basin, and he, the boatman, was familiar with the river. (R. 301.) His boatman had ability to tell where the channel was from surface indications, and in view of the nature of the banks, a man could not be familiar with the navigation on either of the rivers unless he had been on them. His boatman had also been on the San Juan river in boats from Chinle Creek to its mouth. His boatman was an experienced river boatman on the Colorado river and he had gained his experience on that river, the Green and the San Juan Rivers. His name was H. E. Blake, Jr. (R. 302–303.)

He found each of the bars and riffles mentioned in the 1909 Army report, and examined them on

his trip. (R. 303.) He had no difficulty in locating them. They are listed in their proper order and the approximate mileage is given. The study of his report will indicate larger changes than are shown on the plans on account of the fact that the text describes the elevation of the bars and surface conditions, which is not shown on the plans. (R. 304–305.) Half of the bars described in the 1909 report have clumps of willows, the other half does not have them.

The Green River in some places is two or three thousand feet between the canyon walls, and others are not so wide. He has given the average width in his text about one thousand to fifteen hundred feet. (R. 305–306.) Since the 1909 Army report was made there have been a good many floods and high water and all that sort of thing. (R. 306.)

The channels are not stable. Take Brown's Bar, at Greenriver, below the railroad bridge. There is always a bar there because it is at the mouth of Saleratus Wash, but the material making up the bar has probably changed hundreds of times. (R. 307.) He states in his report in great detail what he considers the stability of each bar. The survey of the Army Engineer Corps, 1909, shows that the Butterfly bar separated the river; conditions at the time of his investigation were not materially different; the channel has widened somewhat, but it is still the main channel; the river channel has widened materially. (R. 308.) He

describes in his report why this bar and riffle are there. (R. 311.)

The fact that these bars occupy substantially the same position as in 1909 does not indicate a stable channel. It indicates instability. (R. 311.) For instance, there are bars that are formed in different ways; some bars are formed by a side wash; some are formed in bends; some bars are formed with crossing bars. (R. 311.) Now, there will always be a crossing bar probably in the same approximate location. For instance, Farrer Bar is a typical crossing bar. Now, a bar has maintained itself there for something like 20 years and as far as he knows there will always be a bar there. But the exact channel—there is no relation to the channel over a crossing bar; it changes. The bar, similar to the Butterfly Bar, he has attempted to define how it is formed and the probability as to how long it is apt to stay there. (R. 311–312.)

The San Rafael Bar is at the mouth of a Wash, which is constantly being changed on account of the material brought in. The Auger Bar and Riffle is a riffle at the mouth of a Wash where the sediment is brought in and forces the channel over. He would say that there is no degree of permanence or stability in the channel. The fact that a bar may be there does not in his estimation indicate it is stable. (R. 312.) The bar is not always likely to be approximately at the same place. It depends again on the different types of bars. In the cross-

ing bars in all probability the channel would be at the same place. That is, the channel may cross the bar at any point, although the bar may always be there. This is true as to the crossing bars.

The Butterfly Bar violates every law of ordinary bars in a river in that it is the outside of a bend which receives the direct force of the current. A stable bar and a stable channel do not necessarily go together but vary according to the type of bar. (R. 312–13.) It is a very difficult thing to describe. The bed is certainly not permanent by any means; the banks are not permanent, except where they are against rock walls. (R. 313.)

There was evidence of instability near town of Greenriver; evidence of an old river bed a quarter of a mile away; saw where it used to empty into the Green River and where it formerly left the Green River. (R. 316.)

Soundings represent the depths obtained as boat travelled downstream. River was muddy at times. After he got below mouth of the San Rafael he had to handle canoe, Mr. Blake the other boat. Mr. Moyer took soundings. (R. 318.) Rowing from the mouth of San Rafael, he got a good idea of depth of the river when rowing the boat. (R. 320.)

Bars and riffles, the things between the mouth of the San Rafael and Greenriver, causes the river to be less easily navigated than the balance to the junction and up the Colorado to Moab. (R. 321.)

Did not go above Moab in a boat; the mouth of Sheep Creek, 2½ miles above Moab is limit of navigation because large amount of debris, rock, and gravel is brought into river there and very decided riffle and rapids are formed. (R. 324.) Mr. Baldwin told him that was as far upstream he had ever been able to to go with any boats (R. 324.) He walked along bank, did not get into stream at all; did not have a boat. Gravel and large submerged rocks noted; would not want to go down there with a small boat. (R. 326–327.)

With Colorado type of boat, would not want to go down but it could be done; up to Castle Creek, doubts if a boatman could possibly go up; would be almost continuous portage. (R. 328.)

Other obstructions than those indicated on Plate 37 (R. 328–328–A); does not believe even in smooth water you could go up against the current. Power boat might do it; but it could not go upstream past area shown on map unless it was carried. (R. 329.)

Complainant's Exhibit No. 84 was prepared to show how much more fall these streams have than ordinary streams used in navigation. (R. 382.) Marked differences between other rivers and rivers involved in this case. (R. 333–334–335.)

He states that the facts contained in Compl. Exh. No. 86, being a report on the San Juan River, are the facts as he observed them; that he arrived at the four corners (where Utah, Colorado, Ari-

zona, and New Mexico join) at 12 o'clock, October 26; that he ran a line along the State line between Utah and Colorado, north of the rim of the (San Juan) River, and in the afternoon dropped down and left a bench mark in the canyon. (R. 330–331.)

He explains that Plate 1 in Compl. Exh. No. 87 is a map made by him on that afternoon and the next day. It shows the photograph numbers, the cross sections, and the river survey. He spent from 12 o'clock one day until 3.30 of the next afternoon in making the map, taking photographs and cross sections. (R. 331–332.)

He recalls making a statement on direct examination that it is necessary to examine personally, or know about the tributaries and the entire basin of a river. He had never been at that particular point, or at any point on the San Juan River, either before or after the time he made his survey. (R. 332–333.)

His purpose in preparing Compl. Exhibit No. 84 was to show how much more fall these streams have than the ordinary streams that are used in navigation. (R. 332.) He had in mind the question of navigation when he made this part of his report; that in his comparison of the three rivers involved in this case he took in the larger rivers on which he had profiles and official survey bulletins that could be easily obtained; and that he knew were large rivers, and were generally called navigable. He has

included the Mississippi, the Ohio, the Missouri, and the Columbia. (R. 333.) There are very marked differences between other rivers and the rivers involved in this case.

The Snake and Salmon Rivers in the Northwest are the only two large rivers in the West that he has made a study of. (R. 334.) In making this comparison between other rivers and those involved in this case, he did not use the Snake and Salmon Rivers, as he did not consider them navigable rivers.

He has figures on all the rivers of the entire United States and can produce the figures on the Snake River, similar to that he has produced on the other rivers. (R. 335.)

In stating that the Snake River was not a navigable river he had in mind that stretch of the river as far down as the Pittsburgh Bar, as he knows the Snake River was navigable from its confluence with the Columbia River upstream as far as the bar. (R. 338.)

In taking his figures on the Columbia River, he took from the Snake River on down. He states that the Columbia River rises in Montana, and that the Snake joins it in the State of Washington. He knows that the headwaters of the Columbia River are in the high mountains. (R. 339.)

In making up his report he took the Green River from the Utah-Wyoming State line, located at an elevation of about 5,840 feet (above sea level).

This point is where the Green River flows through the Uintah Mountains. (R. 340.)

In his comparison he took the Columbia River at an elevation of 145 feet above sea level, and in his estimation boats operate up to the Columbia as far as the mouth of the Snake, and on up the Snake River, and he wanted to select a point on the Columbia River where there would be no question of it being navigable. (R. 341.)

He made a study of all the rivers as outlined on the map that covers the Green, Colorado, and San Juan Rivers, above Lees Ferry, on the San Juan to Chinle Creek, the Colorado to Grand Junction, and the Green River to Green River, Wyoming, and the reason his figures stop at Green River, Wyoming, was because that was the end of the river survey. The map he refers to is called Shaded Relief Map of the Colorado and Green Rivers, with Profiles. (R. 341A–342.) This map could have been made half as big, or larger, if he had wanted it. He took the Colorado River from Grand Junction at about an elevation of 4,558 feet. That is also the end of the river survey. (R. 342–343.)

He does not believe the Geological Survey has any surveys on the lower Columbia River or the Snake River, as the Geological Survey does not work, in general, on navigable streams. He knows that one fork of the Snake River rises in Yellowstone Park, and the other west of Yellowstone Park. (R. 343.)

He believes that the elevation of the South Fork would be about 10,000 feet, and the North Fork about 7,000 feet. (R. 344.)

He does not know the elevation of the Sacramento River at the point it rises. (R. 344.)

He computed the San Juan River from Chinle Creek. (R. 345.)

Redirect Examination (Vol. 2, 11. 346–358):

Witness attempted to put into his dairy all of the places where the boat ran onto bars, and the dairy is on file in the Geological Survey. During his testimony he refreshed his recollection from the diary. Many persons in charge of survey parties keep a diary of general interest which is filed separate from the technical reports. (R. 346.)

The report filed by witness was filed in his capacity as hydraulic engineer, and the same remains on file in the department (Geological Survey), for all time. (R. 346.)

So far as the witness knows there is no time of the year when the channels of the Green and Colorado Rivers are entirely dry, there being some water in the channel at all times. (R. 347.) The long-time records of the streams have never shown them dry.

The amount of the water in the channels, regardless of where they lie from year to year, will average more or less the same in each corresponding month of the year. (R. 348.)

Other than the type of boats used by him the large flat-bottom scow of the Moab Garage Company has been up and down portions of the Colorado River, during the same periods of the year when the water conditions were the same as when he boated. (R. 348.)

From his observations, a canoe could be taken down the river at all times of the year. The canoe which he operated drew only three or four inches of water. (R. 348–349.)

In general the width of the Green River through the canyon is from 1,200 to 1,500 feet. The bed of the Colorado River between the rock walls is probably wider. The Colorado is a larger stream than the Green, carrying about 25 per cent more water, and, therefore, in general the volume of water in the Colorado is greater than in the Green. (R. 349–350.)

The slope of the Colorado River bed is less than that of the Green, and although the volume was greater in the Colorado at the time the witness was there, the width of the stream was greater and the depth of water in the two streams was about the same; the general conditions of the two were not materially different. (R. 349–350.)

The word "canyon" as used by witness indicates the entire valley below the Colorado River Plateau. He referred to the canyon as being the rim that could be seen from a boat on the water, which would be like the Grand Canyon between El Tovar and the North Rim. (R. 350–351.)

The average width of the Green River above the San Rafael is not materially different than below.

The rock walls, therefore, which are on either side of the river have little or no effect upon the width of the stream. From Mill Creek immediately below Moab, the Colorado flows into a canyon which has no open spaces as there are on the Green above the mouth of the San Rafael. (R. 352.)

The Green River from Greenriver, Utah, down to about three miles below the mouth of the San Rafael is readily accessible on foot or horseback, but not with motor truck; there is a road along the east side which is back from the river; it might bring you within about five miles of the San Rafael, and on the west side to within about two miles of the San Rafael. There are such roads as you could walk over at night without killing yourself, which indicates they are not exactly a canyon. (R. 352–353.)

So far as he knows, the Green River is not accessible from the plateau after entering the canyon, but he saw wild horses and cattle tracks, indicating that they had found their way down to the river from the plateau. He saw no human beings in the canyon [of the Green]. He saw signs of humans having been at the mouth of Roaring Canyon, from inscriptions on the rocks. At the mouth of Roaring Canyon there is a side canyon that can be ascended onto the plateau. (R. 353.) It is pos-

sible at other places to get into the canyon, but not out, because of the high rim.

The canyon of the Green is more or less continuous, but it is broken by a number of side washes. There are several tributaries that have openings 1,000 feet wide flowing into the Colorado, but in general it (the canyon) is intact. (R. 354.)

He is not familiar with the Platte, Red, Arkansas, or the Rio Grande Rivers. (R. 354.)

Recalled (R. Vol. 23, pp. 4115–4136):

Compl. Exhibit 88 is a compilation of all of the stream flow records collected by the United States Geological Survey at the so-called basic gaging stations on the Green, Colorado, and San Juan Rivers.

Pages 2 to 4 are descriptions of the use of certain plates. Pages 5 to 29 are an index of Water Supply Papers, and other papers of the United States Geological Survey, which refer in any way to the Colorado River and its tributaries, and also a list of all of the gaging stations which have been maintained by the Survey on any tributaries of the river, including the main stream. Pages No. 5 to 29 simply being an index of all the published information available in the Geological Survey relative to the area drained by the Colorado River and its tributaries.

From page 30 to page 109 are compilations of all of the records of the Geological Survey, as taken from the published reports for the various gaging stations, and also from the unpublished reports for

the various gaging stations, but which are now in process of being prepared as Water Supply Papers.

The tabulation given therein contains for ready reference all of the information relative to the stream flow of these streams at the various gaging stations for the entire period covered by the records.

Take, for instance, the gaging station at Lees Ferry. Page 38 indicates the pages of the various Water Supply Papers which contain the published records. The table on page 39 shows for this station, first, the run-off for each year as published, the discharge in second-feet for the year; the minimum day for the year; the maximum day for the year; and the ratio of the run-off for that year to any other year. In other words, the ratio between the run-off for that year and the mean annual run-off.

The second table on page 39 shows the total amount that runs off in any one month, based on all of the records.

The question has been asked many witnesses, During what months the run-off occurs? This table (indicating) which is in the book for each of the stations, shows the amount of water that runs off for any particular month on the average. In this particular example at Lees Ferry, the amount of run-off for the season varies from 2.4 per cent of the total, during January, to the high month, in June, when 25 per cent, or one-fourth of

the entire water in the basin runs off during one month.

Now, the tables on pages 40, 41, and 42 are especially illuminating, in that they show, for ready reference, the flow by months, in order that they may be compared with the same flow for the same months in another year. In this particular case, I think they are very important. For instance, on page 42 is shown the mean run-off of the Colorado River at Lees Ferry, for the month of September, 1921 to 1928.

1921 was the period in which all of the river surveys were made.

The topographers were working on the river. In 1922, he believes they have a record of the river as noticed by the party of engineers who made a trip from Halls Crossing to Lees Ferry.

The Stabler-LaRue party. The table shows that during 1921 the mean flow was 12,500 second-feet during September.

The mean flow for September, 1922, was 7,000, or nearly half as much as the flow during September, 1921.

The flow is also given for all of the Septembers in that same total, which shows that the September flows during the various years have ranged from a mean of only 5,000 during 1928, to 34,000 during 1927. The average flow for September, based on these records, is 12,600 second-feet. In other words, a party going through the river in Septem-

ber, 1921, would meet conditions, as far as flow is concerned, which is the average for September, based on these records, from 1921 to 1928.

A party who had gone through the canyon during September, 1922, would have flow conditions corresponding to one about one-half of what might normally be expected during September.

A party going through in September, 1927, would have had flow conditions two and one-half times of what would normally be expected during September.

Now, in case the maximum and minimum flows are desired to be known for any particular months, those are given in these. In 1920, one party had flows ranging from 6,830 for a minimum, to 25,200 for a maximum.

The tables show not only the flow occurring during the month, but for ready reference the comparisons with similar flows of other months.

It contains a similar presentation for all of the gaging stations, Cisco, Lees Ferry—all of the gaging stations on the Colorado and Green rivers which have been referred to in the case, and for which the original records have been introduced.

Going over further, on page 44 is a table which shows a compilation for ready reference of the flows that have been recorded at Lees Ferry during the period 1922 to 1928. This table is of importance in the case. For instance, with a flow of 7,000 second-feet at Lees Ferry, this report shows

the number of days the flow has been below or above 7,000 second-feet for each month of the year for the entire period of record.

The table covers all the flows from the minimum to the maximum. (R. 4115–4120.)

To explain that document and how it can be used. The character of the river has been shown to vary so much, depending upon the flow. The flow, materially changes the characteristics of the river. Now, if the river is described at a time when the flow is a certain amount, it is of value without going through all of the records to have in ready form the number of days throughout each month, based upon the records when the flow has been below or above this amount. When you speak of the average flow of a river, there are such a very few days in the year that the flow is the average amount—only about 25 per cent of the year. For the remainder of the year the river is below the average flow or above the average flow, and this table shows how many days the river is above or below on the day that may be desired—he means any flow that has occurred on the river.

These tables and the compilations of these tables were also the basis of curves which have been introduced as Compl. Exh. 82–A. (R. 4120–4122.)

The table on page 87 shows that during September, on the average there are seven days when the flow is less than 2,000 second-feet, and 23 days when the flow is above 2,000 second-feet during September.

The table also indicates that during the year there are 77 days when the flow is below 2,000 second-feet. In other words, based on the past records, there are 77 days in the year when you would expect a flow less than the day upon which he made his trip, and seven of them have more on the average during September.

Gaging stations are selected and operated by the Geological Survey at sections where the bed is as stable as possible, and in sections where the river is straight, where the velocities are distributed uniformly throughout the cross-section. The bed should be stable in order to minimize the work that has to be done; the channel should be straight, in order that the velocities may be evenly distributed throughout the cross-section. All of the gaging stations that are maintained by the Survey on the Colorado River, the San Juan and Green Rivers, are located with these points in view.

Plate 2–A, Compl. Exh. 82–A, is a cross-section of the channel at the measuring cable at Lees Ferry, showing range of change and the characteristic changes in the channel itself caused by scour and fill. These curves are plotted cross-sections from actual field measurements made during the course of determining the flow of the water during a period from November 22, 1924, to July 11, 1926. (R. 4122–4124.)

To explain the Plate. The first measurement of the series shown on this plate was made Novem-

ber 22, 1924. The cross section and the elevation of the bottom of the river at that time is indicated by a line, which is indicated No. 1, November, 1924. The second measurement of that series plotted on this sheet was made September 11, 1925, and is shown on the cross-section as a line dated September, 1925. It will be noted that at Station 250, the lines for these two cross sections indicate that at Station 250 feet from the right bank, that particular portion of the river bed was the same; at station 200, the measurement made in September, 1925, was approximately a foot and four-tenths above the bed of the river, as shown by the measurement made in 1924, indicating at station 200 a fill of 1.4 feet. Going to the section of the river lying to the right of 250 station, between 250 and 500, the cross-sections indicate a scour throughout with a maximum of about three feet at station 375. Taking another typical example, the change in the cross-section shown between May 12, 1926, and May 30, 1926, these tables indicate a scour throughout maintained to an average of about approximately seven feet—a scour throughout the greater portion of the bed of the river.

The maximum change in the bed of the river, as shown by these measurements, is between measurement made November, 1924, and July, 1927, which at station 480, amounts to approximately 17 feet of scour in the bottom of the river. (R. 4125.)

Probably changes occur back and forth, depending upon the floods that may have occurred between those two dates—the dates as shown on the plate and on the cross-sections.

Measurements were made approximately every day at the Lees Ferry gaging station. It would be possible to show the change each and every day by means of plates like this.

Those measurements are taken from a cable car. The station is a fixed point, and a cable car with a lead weight varying from 75 to 100 pounds in connection with the measurements of the daily discharge.

At station 450, between those particular dates when that measurement was made, the depth of the water was 17 feet greater at station 450.

So far as he knows, there is no peculiar condition which brings this about; as far as he knows, this condition is not peculiar to that place. He would say off hand that it would apply to any section of the Colorado River below Cataract Canyon.

So far as he knows, there is nothing peculiar about the bed of the river at Lees Ferry that is not also found along the Colorado River from the San Juan down, except at such points as there may be rapids or riffles or gravel bars. Showing again that the change does not progress always downward on this same sheet is shown in the cross-section taken May 30, 1926, and June, 1926. Between those two points, in the majority of the cross-sections there was

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a fill amounting to almost four feet throughout the greater portion of the cross-section, and a scour of a foot between Stations 325 and 369.

In other words, this chart shows the rapidity of the amount of scour and fill taking place in the Colorado River at Lees Ferry, as shown by actual measurements made.

Similar characteristic information is shown for each of the gaging stations on Plates 1–A, 2–A, 3–A, 4–A, 5–A, on which is shown the Colorado River near Cisco—Lees Ferry. Before we leave Lees Ferry, Plate 3–A shows the rapidity with which changes may take place, as shown by five measurements made May 2, 1927, May 3, 4, 5, and 7, showing the scour and fill in a period of three or four days; the Station at 250 having a scour of five feet during that period; the Station at 340 feet, the maximum change was only a foot, indicating at that particular place in the cross section that there was only a change of a foot during that period; while at Station 460 there was a scour of approximately four feet during that same period. The plate shows the rapidity in which the bed of the river changes, and gives some idea of the magnitude.

The data produced here at a gaging station is the only place where it is possible to get measurements of this kind; it is the only place where measurements of this kind have been taken, as far as the Geological Survey is concerned.

Irrespective of scour and fill there is some kind of normal flow. And in the characteristic readings as shown at the gaging stations there is an attempt to show what that normal depth is. Each river has to make its own law, according to the amount of silt in it.

They show the depth of the river at these times. And other plates will give the depths throughout the year at the gaging stations.

The original notes of these measurements are kept by the district offices. The district offices were asked to supply this office with depths cross sections of the river at their gaging stations, based upon at least ten measurements, and if those ten measurements did not in their estimation furnish typical cross sections, to furnish more measurements.

The cross sections are typical. Now, if for any reason they are not typical, the original notes for all of the measurements for all of the stations could be plotted, but even this sheet with ten cross sections on it is pretty confusing. If more were put on, it would be almost impossible to make heads or tails out of the cross sections.

So far as the Geological Survey is concerned these are straight, typical changes in the bed of the river at the gaging station. Some of the district engineers took some periods, and some took others.

The figures given at Lees Ferry by date and by discharge are representative. The dates so taken as to include minimum and maximum flows, and

represent a picture of the condition. The information on Plate 3–A contains the date of the estimate, the engineer who made it, the width, the area, the mean velocity, the gage height, the discharge, and the official number of the measurement—all of which are published by the Geological Survey.

Plates 1, 2, 3, 4, and 5 show the characteristics of the river, as shown at these gaging station.

Plate 5 is based on measurements made at Lees Ferry, 1921 and 1922; some thirteen measurements being used for 1921 and some 89 measurements being used for 1922. The first curve on the plate shows the approximate relation between the stage of the gage height and the flow of the river; these are based on the measurements made covering the entire range in stage. This relation is approximate only, as are all of the relations shown on these plates, because of the fact that the rivers are subject to scour and fill, and no one curve can accurately depict the true relation between those amounts.

The first curve shows that the discharge varied from about 5,000 second-feet, or less, for a gage height of about 7 feet, to approximately, 115,000 second-feet for a gage height of 20 feet; in other words, with a 13-foot rise in stage at Lees Ferry, the discharge increases from 5,000 to 115,000. This curve shows the rate of change and gives the approximate discharge for any stage. These curves are the basis of the fall of the stream flow records which are published by the Geological Survey for Lees

Ferry. It merely shows that the more volume the higher the water rises. And it is the relation from which the discharge is computed. The approximate flow can be determined from this curve. From that also the velocities and depths.

The second curve represents the approximate relation between the stage and the cross-sectional area, as shown on the first plate, that is, the number of square feet in the cross section of the river. The scour and fill of the stream is indicated also on the curve. For instance, between measurements 152 and 162, both are made at approximately the same gage height of 17.8. The area in cross section of the water when measurement No. 152 was taken was 8,000 square feet. The area of the water when measurement No. 162 was taken at the same gage height, the same stage of water—the cross-sectional area was 10,000 feet. In other words, between those two measurements, 2,000 square feet of the bottom of the river on that cross section had been scoured out by the water.

Now, the scouring out of the cross section changes all the velocity.

The third class is an indication, or approximate indication, of the relation between stage and velocity of the river. Given the same volume of water you would get the same velocity.

What this shows is, say you have a certain stage of water, say, at this particular place, of 18 feet:

You ask what the velocity is when the water is 18 feet on the gage. That depends upon how much cross-sectional area you have. As shown here you can come out with one area in the same stage of water, at a velocity of five miles an hour, and at another point at the same stage of water have a velocity of nearly seven miles an hour. And further down, at stage 11 feet, as shown by the measurements, although the water was at the same stage, there was a velocity of 3½ miles an hour for one measurement, and nearly five miles an hour for another measurement, due to the fact that it had scoured out.

The extra velocity is caused by more water. The total amount of water equals the area by the velocity. If you leave the gage height the same, but you increase the area, you decrease the velocity. If you leave the gage of the water the same, but fill in that channel, you increase the velocity. That is if you leave the stage of the river the same, but fill in the channel by a fill, why, if you have to pass the same amount of water at a given point, you have to increase the velocity. (R. 4124–4136.)

Recalled. (R. Vol. 23, pp. 4142–4161.)

The zero of the gage is an arbitrary point, taken always below the known bottom of the river. The zero of the gage does not mean anything at all, except as an arbitrary point from which all of the gage charts are referred back. It does not repre-

sent depth of water. The zero represents nothing excepting the starting point for the gage heights.

The gage height as such has nothing to do with indicating the depth of the water. The gage is simply a means by which the fluctuations from low water to high water can be obtained. On one gage low water might read 20 feet; on another gage it might be five feet. Neither the zero of the gage nor the gage heights have any relation to the depth of the river.

In using the gage height, the figures as to the height of the water by the gage has no relation to the depth of the water in the stream.

To explain that by the gage at Lees Ferry. The zero of the gage, we will say, is at some point lower than the surface of the water. It is always picked so that we will never have a minus gage reading, if possible. Now, the lowest gage reading at Lees Ferry, as indicated on Plate 5 of Compl. Exhibit 82–A, is about 6.8 on the gage. When the gage read 13 feet, you would know that the depth was at least between 6.8 and 13 feet—that the gage would show at least that much.

A gage height as used by the Survey is simply a measurement of the surface of the water. It has no relation at all to the depth. The depth of the water does not enter into the gage heights.

In connection with the preparation of material, he has attempted to work up from the measurements made at the gaging station, which were made

primarily for the purpose of determining stream flow, what the depths and velocities were at the gaging stations, as shown by the measurements.

Given the gage alone he is not able to compute the depths; you would have to have a study of the gage heights and discharge measurements, from which the actual depths and cross-sections were obtained.

He is able to determine depths and velocities, with reference to certain gage heights which are shown on these plates.if given the gage heights and discharge measurements.

The width of the stream enters into the computation of discharge.

All of the plates now being discussed, 1, 2, 3, 4, and 5, show for the gage stations the approximate relation between stage and depth and stage and velocity. Using Plate 5, with reference to the gaging station at Lees Ferry, the question is as regards relation between a gage height and mean depth? The curve to the right of Plate 6 shows the approximate relation between stage of water at Lees Ferry and depth. It shows that at a stage of 7 feet, the mean depth of the water is 4½ feet. At a gage height of 12 feet, the mean depth is 14½ feet. It shows that at a gage height of 19 feet, the mean depth is approximately 26½ feet. It will be noticed that was a very wide discrepancy in the plottings, due to the scour and fill of the river. The

line as drawn is an attempt to average out those conditions and give a so-called mean or approximate relation. This relation here shown on Plate is the same relation to other measurements that have been used in here, and the curve shows the relation between all of the other measurements used in preparing this table. This curve represents the general average of the depths of the river, as compared to the gage readings. In other words, here are the plotted points upon which that curve is based. This Plate represents measurements made in 1921 and 1922—nineteen different observations, ranging in gage from 7 feet to 20 feet, well distributed.

The cross section of the river was taken a thousand or more of times; every time there is a measurement made there is taken a cross section of the river.

To find depth, strike some sort of an average or composite figure of those various cross sections. That is what this Plate is.

On the particular day in question on which these measurements were made, the characteristics as shown on Plate were observed. There were enough measurements taken, in his estimation, to show a composite picture. These represent conditions as they were on the day when the measurement was made—the relation between stage and velocity, velocity and area, and discharge, based on actual discharge measurements.

For each measurement all of these factors can be obtained from it. You can determine the discharge; you can determine the cross-section; you can determine the mean velocity; you can determine the maximum velocity; and you can determine the mean flow. Each measurement used showed him all of those things.

Now, approximately there is made 365 measurements a year at Lees Ferry. Since 1921 there have been thousands of measurements made, from which any one of these points could have been determined. He simply took those measurements for 1921 and 1922 to show a picture. He could have taken 1921, 1923, 1927, and 1928—any one of the thousands of others—as long as he had a composite picture there, high water and low water in all seasons.

In making up sheet for 1921 he considered all of the measurements that were not affected by ice between 2 and 15, the number of the measurements—or sufficient measurements to get the range and stage from high water to low water; the measurements used—if necessary, he can look to the field notes and show the dates for which those measurements were made.

This plate was made up to show, to the best of his ability, the approximate relation between the various elements he has shown for the Lees Ferry Station. These charts as far as the observed velocities and depths were concerned, were prepared in order that he might show a picture of the depths

and velocities obtained throughout the year graphically.

Plate 6 shows, for the different gaging stations, the number of days, graphically, that the flow was above or below certain amounts between zero and 30,000 second-feet. Taking the example at Lees Ferry, based on all the records of stream flow available, the flow has been above 6,000 second-feet for 295 days, and below 6,000 second-feet for the remainder of the period of each year, with a minimum of 2,000. That same data is shown for each of the gaging stations. It shows graphically, for the purpose of comparison of any particular trip on any stream, knowing the stream flow, based on the records for that particular day—it shows how many days the flow has been below or above that point on the river.

Taking his trip on the Green River as example, with approximately 2,000 second-feet he can determine from that chart how many days in the year you would, in all probability, have that much water. Taking the point where the 2,000 second-foot line crosses the Green River line, showing that there are somewhat over 280 days with a flow of more than 2,000 second-feet, and the remainder of the year is less than 2,000 second-feet. That is given in tabular form.

Those records are based on the periods, as shown on this particular graph. Having determined the percentage of time and the number of days the

flow was above or below certain amounts, and knowing the relation between the mean depths and the maximum and mean velocities for certain flows, it is possible to work up Plates 7, 8, and 9.

Plate No. 7 shows, for each of the gaging stations, the number of days in the year when the maximum velocity in the thread of the stream would be above or below certain velocities in miles per hour.

Taking, for example, the San Juan River at Bluff, which station for the greater portion of the year has the highest velocities. Take a velocity of four miles an hour, for example. It shows that the velocities in the thread of the stream at the Bluff gaging station are above four miles an hour for 346 days in a year.

The Colorado at Lees Ferry has a velocity in excess of four miles an hour for 226 days. The Green River at Greenriver, Utah, has a velocity in excess of four miles an hour for only 85 days. The Colorado River at Cisco has a velocity in excess of four miles an hour for 78 days. The Green River at Green River, Wyoming, has a velocity in excess of four miles an hour for only approximately 18 days in the year.

Plate No. 7 shows the velocity in the bed of the stream at the gaging stations.

To the best of his knowledge and belief, conditions at the Greenriver gaging station, at Little Valley, as far as the velocities and depths are con-

cerned, represent conditions fairly accurately from the San Rafael to the mouth. In the absence of any other information he would accept the records at that station.

He is unable to give any information as to what extent the records of the gaging stations at Bluff indicate conditions on the San Juan.

To the best of his knowledge and belief, the Lees Ferry records, as far as velocities are concerned, and possibly depths, represent conditions through Glen Canyon below the mouth of the San Juan.

He would expect, knowing what he does of the San Juan, that the Bluff records might indicate conditions between the rapids and riffles. The records at Bluff would not in any sense indicate any velocities on the San Juan River; that is, the gaging station is so located—on account of the velocities that are encountered, the gaging station is so located that it is on the quietest place on the San Juan River, in order to be able to obtain some observations. The gradient is, it is true, an indication of the velocity. Other conditions being equal, the velocity varies per the square root of the slope. To be exact, the velocities are equal to the constant of the square root of the hydraulic radius and time and slope. Now, if the cross-section of the bed remains the same, and you have exactly the same cross-section at another point of the stream; you have exactly the same character of bed. In other words, if your constant and your hour and hydrau-

lic radius are the same absolutely, then it is possible to determine the velocity at some other point by use of the slope. Otherwise, unless the character of the bed and the cross-section remain the same—the velocities do not vary—unless the character of the bed and the cross-section remain the same, the formula can not be used.

Plate 8 represents the relation between the mean velocity in the cross-section and the gage heights. This plate was prepared in connection with the determination of the maximum velocities. It shows the mean velocities in the cross-section. In that connection, while talking about velocities reference is made to Plate 12, which is a cross-section of the river at Lees Ferry, as based on observations made May 31, 1924, which shows to what extent the velocities and the cross-section vary at any particular time. When that measurement was made, the velocities varied from a maximum of 8.86 miles an hour to less than one mile. 8.86 miles an hour, or nearly 9 miles an hour, in the thread of the stream, to less than one mile an hour at the banks, and to less than 5 miles an hour at the bottom in the center of the stream.

At that time, when the measurement was made, the No. 1 gage read 18.3; the river gage 13.87; the cable gage 12.80; and the width of the river was 410 feet. The area was 6,850 square feet; the discharge was 59,400 second-feet.

The ordinary mean flow at Lees Ferry is around 10,000. The average flow is 20,000.

That curve just represents the usual conditions and gives the picture throughout the year.

The usual conditions throughout the year are shown on Plates 7 and 8.

The maximum velocity shown at Lees Ferry ran from say 3 miles an hour for thirteen days, up to over—it runs off the sheet at 7½ miles an hour for 80 days. In other words, conditions as shown on here probably only obtained for forty days during the year.

To be exact, the flow is over 60,000 second-feet, or over the flow upon which those velocities were obtained, for 31 days in the year; for 31 days in the year, on the average, the velocity was higher than the velocities indicated on that plate.

Passing now to Plate 9, which is another attempt to show the characteristics of the river as shown by the gaging stations, these are plates which indicate the mean depth of the river at the gaging stations.

Taking a depth of five feet as an example, which is at Lees Ferry, a depth of five feet or greater is expected for 280 days. At Green River, Wyoming, a mean depth of five feet for 140 days. At Greenriver, Utah, a depth of five feet for over 120 days. For the Colorado River at Cisco, a depth of over five feet for 110 days. For the San Juan River at Bluff, a mean depth of over five feet for 80 days.

In general, as to mean depths, there is no portion of the year when the Colorado River at Lees Ferry has a mean depth of less than 3½ feet; or at Green River, Wyoming, 3.2 feet. There is no day in the year when the mean depth at Cisco is less than 3 feet. There is no day in the year when the mean depth at Green River, Wyoming, is less than 3½ feet.

There is no day in the year when the mean depth is less than about 2 feet at Greenriver, Utah. On the San Juan River at Bluff, there is no day when the mean depth is less than a foot. There are 200 days in the year when the mean depth at Bluff is more than 2 feet.

On Plates 1–A, 2–A, 3–A, 4–A, and 5–A, are shown the cross-sections of the river. An examination of those cross-sections will show that, in general, the maxium depth is not more than 20 or 25 per cent, in general, greater than the mean depths.

Plate 10 is an indication of the width of the rivers, compared to different depths. It needs no explanation. It indicates that the Green River, at Green River, Wyoming, for instance, varies in width at the gaging station from about 330 feet to 410 feet. And similar information is shown for Greenriver, Utah. The San Juan River at Bluff varies from a width of about 115 feet to a width of 210 feet.

When he says the Bluff station he means the gaging station near Goodridge. It is at Goodridge near Bluff.

Plates 11–A and 11–B are observations made from which the plates just described, which shows the distribution of velocities in the cross-section, was obtained.

Plate 13 is simply a large size scale of the condition at Lees Ferry.

Plate 28 of Compl. Exhibit 79 shows, for all of the gaging stations throughout 1928, the deficiency curves by months, based on something like 33,000 observations. In order words, it shows the number of days in each month that the flow, based on all of the daily observations made by the Survey, has been above or below certain quantities. It is a condensation of something over 30,000 daily observations of stream flow for all of the stations from Green River, Wyoming, through to Topock, and represents in the simplest form all of the characteristics of the stream flow of the various rivers. (R. 4142–4161.)

JOHN F. DEEDS

For Complainant

(Record Vol. 2, pp. 358–360)

He resides in Washington, D. C. He is Chief of the Agricultural Division, Conservation Branch, Geological Survey, Washington, D. C. (R. 358–359.)

Complainant's Exhibit No. 99, examined by him. It is a precipitation map of the Colorado River basin, of Utah, Wyoming, and Colorado, repre-

senting a consummation of work from 1917 to 1926 (R. 360), and is identified as having been prepared under his supervision, the compilations thereon having been made partly from records on file in the Department and partly from records in the United States Weather Bureau. The United States Weather Bureau is a bureau in the Department of Agriculture. (R. 359–360.)

KUMEN JONES

For Complainant

(Record vol. 3, pp. 362–420)

He resides at Blanding, Utah, is 73 years of age. He is a cattleman and has lived in Blanding and vicinity from 1879 to the present time. He migrated to San Juan County from Cedar City, Iron County, Utah, in 1879. He first left Cedar City, Iron County, with an exploration party of twenty-two in the spring of 1879, traveling easterly over what is now the road to Grand Canyon, crossing the Colorado River at Lees Ferry, then proceeding northeasterly [crossing the San Juan River at the present location of Bluff]. The party then proceeded northerly to Blue Mountain [near the present site of Monticello, Utah]; thence to Moab, Utah, crossing the Grand River at that point, thence northwesterly to the present site of Greenriver, Utah, crossing the Green River just above the present site of the Green River bridge. They then proceeded southwesterly and returned to Cedar City

where they organized a colonization party. (R. 362–364.)

In October, 1879, the party consisting of two hundred-odd persons left Cedar City with eighty-two wagons and traveled easterly, crossing the Colorado River at the Hole-in-the-Rock they proceeded to the present site of Bluff, making a good road all the way and established the town. (R. 364.)

He has traveled overland up the San Juan River from Bluff, a distance of one hundred miles and down the river as far as its confluence with the Colorado. (R. 366.)

Never saw Indians use boats except for the purpose of crossing the river and never used boats on the river for travel himself. (R. 365.)

When this party of Emigrants reached Bluff the river was confined in apparently a permanent channel with cane, willows, and cottonwood trees; since then it has been tore out, all to pieces. (R. 366.)

They laid out farms and irrigation projects that would be on a small scale nowadays, but he believes roughly they consisted of about seven hundred acres and dug a gravity ditch from the river. Part of the gravity ditch is still there, but the original farmlands are not, as a great deal has been tore out, washed away by the river. This has been going on year after year, tearing and cutting out a little more each year. (R. 367.)

Supplies were brought into Bluff from Delores, Alamosa, Durango, Colorado, and Thompson, Utah, first by means of team and wagon and later with automobile trucks. The river was never used as a means of transportation for supplies or otherwise. Alamosa was about three hundred miles from Bluff and he believes the road to Durango was completed in 1882.

No supplies brought to Bluff, Utah, by way of Colorado and San Juan Rivers. (R. 369.)

Supplies for placer mining operations below Bluff on the San Juan River were transferred from Bluff by means of team and wagon. Took supplies to these placer mines in wagons. (R. 367.)

During the flood periods and high water the river changes its channel very rapidly, sometimes causing considerable destruction to the bottom lands along its course. (R. 369.)

He recalls floods that have happened on the San Juan River and while he doesn't remember the year, there have been terrible floods down there; in 1886 the first serious flood we had tore up things and ruined their ditch. (R. 369.)

The channel will cut from one side to the other; one night it would be deep on one side and shallow on the other; the next morning likely the current would be cutting the other way.

Have heavy rain storms usually in July and along in September. (R. 370.)

In the late summer, fall, and winter, the water in the river becomes very low except during short periods of heavy rain and cloudbursts. He recalls one time when the river was entirely dry.

The only time he has ever seen the river dry was in the late summer, right at Bluff. Water was entirely gone. No running water at all; stands in pools that run very short distances, but no running water all the way through. That would extend down towards the Colorado River, as far as he could see. (R. 370–371.)

At times the San Juan River freezes over solid. (R. 370.)

There are no large streams come to the San Juan River below Bluff except in rainy times. He means from Bluff to its junction with the Colorado River. The streams coming in are dry washes except in the spring and during stormy weather. (R. 371.)

There is a good deal of flat rock on the mesas in places. The water gathers quickly from these places into the River and "become a raging torrent." (R. 372.) This sometimes causes scouring against the irrigated farms. To protect the farms from the River they built rip-rap, log cribs, and would load them with brush and rock and drive piles, but they didn't have very good success as the floods would tear them out, undermine them, and get around them, ahead or below them. (R. 372.)

He believes he has been principally running cattle ever since he first went into the country and

is familiar with the country from Bluff, Utah, down to the Colorado River and he has seen most of it north to the Colorado River and has run cattle in there. There are not many inhabitants in the country and in the San Juan country on both sides of the San Juan River it is very rough and broken but there is good grazing on the benches when they have good season and is a good cattle and sheep country. (R. 373.)

He knows of nobody living on the San Juan River west of Bluff and it is uninhabited except with Indians who come on both sides of the river. Mexican Hat, he believes, during its boom days didn't have more than fifty men in it at its best and there are only two or three outfits there now. Between the San Juan and the Colorado River no one lives in that country except in cow camps. (R. 374.)

During the early spring run-off and floods caused from cloudbursts, considerable débris and sand is carried down the river. (R. 375.)

Has seen sand waves on river 4 or 5 feet high. (R. 375.)

There are rapids on the San Juan River between Bluff and the Colorado River. (R. 376.)

Cross-examination (R. Vol. 3, pp. 376–403):

There are towns and people between Bluff and the town of Moab and he didn't say there weren't on direct examination as he lived in Blanding himself and Blanding has a population of nine hundred or one thousand.

Monticello is east of the Colorado River and there is also La Salle and ranches and people living along the high-way. The San Juan country is sparsely settled as compared with inhabited sections in the east and other parts of the country. He believes the population of the county is somewhere near four thousand. He believes there are approximately four thousand people living in the section between Bluff and Moab and east of the Colorado River. (R. 377.)

It looked pretty tough to him when he first went in there but he knew there was some good country. He didn't have his pick or he likely would not have stayed there, but if necessary he can tell just why he went there. Generally speaking the people in the San Juan country are like people living other places, and for a great many years all of them have come in there of their own free will and there is no law against their leaving. (R. 378.)

There are vast areas of virgin country that have received very little attention in the way of development and they are suitable to great development, and from his knowledge of the country he has no doubt that the section will be greatly developed. There is a great empire in there.

He is not a miner and doesn't know much about the mineral end.

What he means by development is that there is a lot of wonderfully good land down there for raising grain and crops, one of the best dry-land countries in the world, he believes. (R. 379.) Between this

good country and the Colorado River there is a lot that will never be farmed, he believes.

San Juan county is a large county; one-ninth of the state and the part that is suitable to the development of grain is near the Colorado [State] line; all along there for twenty or twenty-five miles wide and is located east and north of Bluff. There are large sections of excellent grazing land there. (R. 380.)

He does not believe there are sections of land right up to the Colorado River that are much good for anything. (R. 380.)

He has not been up and down the Colorado River between its confluence with the Green and its confluence with the San Juan Rivers. He has only crossed it in every way he could between Moab and Lees Ferry but has never navigated it either up or down and has never lived close to the river. (R. 381.)

He has lived in Blanding for ten years and prior to that he lived in Bluff for over forty years. In his fifty years experience, he believes, that he has crossed the San Juan River below Bluff hundreds of times, principally near Bluff and where the canyon boxes up. (R. 382.)

From a point fifteen miles down the river below Bluff to the confluence of the San Juan and the Colorado Rivers he has crossed the San Juan River nearly every place he could get to the river on horseback. He was in the country looking after cattle and trading with the Indians.

He principally grazed cattle about fifteen miles below Bluff but some of his cattle would go on over.

He knows where Chinle Creek is. (R. 382–383.) He has crossed the river there a good many times and has ridden up and down Chinle in all directions. Below Chinle he has crossed a good many times but he couldn't tell just how many. (R. 384.) After you get down thirty-five miles there is a patch in there below, he has been there to the river in one or two places. (R. 384.)

He has seen perhaps one hundred different small boats on the San Juan River owned by different individuals and a good many owned by himself and partner. (R. 384.) These boats were used merely to cross the river. He has seen a boat or two go up and down the San Juan River. He doesn't believe that he has seen more than two. The first one came down from Farmington N. M. They were going down to the placer mine below Bluff taking supplies. He doesn't know exactly how far they went below Bluff, but some of them went below Chinle Creek. He believes in this first boat there were three in the party and carrying food and lumber to make sluice boxes. (R. 384–385.) He believes it was in the fall in the low water season and was approximately thirty or thirty-five years ago.

The second boat he recalls navigating the river was approximately thirty years ago and there were two or three men in the party. He doesn't know whether they were miners or not but they were go-

ing to the placer mines. They were coming from Colorado and came down the river to the placer mines. He believes they were carrying just provisions and a few tools and a little lumber.

He has never been much interested in mining and he happened to be in Bluff when these two parties went through. They landed there and he was running a store and they came for supplies and he happened to be in the store when they were passing by. There are the only two that he now recalls. (R. 387.)

He recalls the placer mine excitement on the San Juan but not so distinctly on the Colorado. The boom lasted a year or two and there were other minor excitements from time to time during the last fifty years; but very few for the last ten years. (R. 387–388.)

There were not many floods in a single year on the San Juan River but such floods as they had during his fifty years' residence would come along in the two seasons, July and September. (R. 388–389.) About one good big flood a year is enough. They wouldn't average that; many years don't have these big floods. Ordinary years just have regulation high and low water. (R. 389.)

There were two occasions in his recollection when there was no water running at Bluff in the river. One occasion was twenty or twenty-five years ago, and the other occasion was more recent. These were the only two occasions when he has ever known

of such occurrence in his fifty years' residence in the vicinity; forty years of which were spent right on the river. (R. 390.) It was dry below Chinle Creek; dry all the way. (R. 390–391.)

He doesn't know whether at times there is considerable flow of water under the surface; the underground flow. It will seep along and come in again as a stream, but practically no big stream he had ever seen or heard of. (R. 391.)

Some years the river is much lower than others but when the two parties went down they were very dry years. (R. 391-392.)

The river may have been higher for many seasons after that than it was when they went down, and many years it may have been much lower. (R. 394.) There have been other occasions when the river was higher and other occasions when it was lower. When he arrived at Bluff with the party of two hundred or more, the river was confined at that time to a good channel and with willows, cane brakes, and had the look of age and stability. The banks of the stream were well confined at that time. (R. 395.)

The first problem was to solve where they would build their town and it was necessary to look about and become familiar with their surroundings and he went up and down the San Juan River for considerable distance on land. They went down some of the side canyons and explored some of the territory adjacent to the San Juan but at that time the

trips did not extend pretty well down to the confluence of the Colorado and immediately after the arrival he dosen't think that any of the party went twelve or fifteen miles west of where Bluff is now, but in the next succeeding two or three years they made further explorations. (R. 395–396.)

He believes it was nearly ten years after he was there that he made a substantially full exploration of the river down to its confluence with the Colorado.

When they came into the country between the Hole-in-the-Rock and Bluff they came right over the rough country but they did not touch the river till they got ten miles below Bluff. (R. 397.) He would say that the approximate date when he acquired the knowledge of the San Juan substantially from the San Juan down to the confluence would be fifteen years. During the first fi[illegible] years he gained a familiarity down below Chinle Creek, but not very far below as immediately below Chinle the canyon boxes in.

He believes the first big flood was in 1894 and 1896. They arrived April, 1880, and about five years after their arrival would be nearer to the time of the big flood and it tore out some of the farms but did more damage to the canal than anything else. (R. 398.) The next big flood was in 1895 and 1898 and at that time he had been down about twenty-five or thirty miles or ten or fifteen miles below Chinle Creek. (R. 399–400.) There has not been

much change in the channel from Chinle Creek down to the confluence as the stream is confined. There is some shifting and small bottoms in a place or two but it is a stable channel.

In making the examination of the territory at and in the vicinity of Bluff when he arrived there he saw no evidence that the river had changed its course within any recent period. There were little sections where he saw very large trees that had come down with the stream sometime. They were away from the river but it had been years before that time. (R. 400.) He was able to tell from appearances that it had been many, many years before his arrival but he couldn't even make a guess as to the number of years. At the place where he saw some big trees where there might, at some early date, have been a different channel, it would be nearly half a mile from the river and there was more than one place but whether this occurred during one excessively high flood before the white man got there he couldn't say, as the channel was fixed and definite when he arrived and had definite banks and lined with old trees and old willow patches. (R. 401–402.)

The first flood changed it some but not for any considerable distance and when the flood subsided it resumed its old channel in most places or practically entirely. (R. 402.) When the second flood came along the position of the river changed while the flood was on and at most places it did not go

back to its original position. He believes that this was about 1898 and to the best of his knowledge there was a stable fixed channel with no substantial change from the time he first saw it until about 1888. (R. 403–404.)

Redirect examination (R. Vol. 3, pp. 404–407):

Most of the land he speaks about that is suitable for development for grain and other agricultural purposes lies east of a line drawn through Blanding. There may be small patches of country west but the greatest part of it is east and north of Blanding and most of the inhabitants of the county live east of Blanding.

He has crossed the Colorado River at six places; at Little Grand Valley, where Moab is, Dandy Crossing, Halls Crossing. Dandy Crossing is at the mouth of White Canyon and Halls Crossing is about twenty-five or thirty miles below Hole-in-the-Rock and Lees Ferry.

He has not taken cattle across at these places but has swam horses a good many times. Cattle have been taken across, however.

When he referred to the channel of the San Juan River below Chinle Creek he meant it was confined in a canyon. He has been right down to the river itself below Chinle Creek; in a dozen places below Chinle Creek and where the Goodrich Bridge is below Mexican Hat. (R. 405–406.) He has not been down in a boat but just in places where trails

go down to the river but he has actually been in the river.

There are small sand bars on each side of the river and the sand bars will change about and sometimes get solid rock on one side or the other.

When he first went into the country he was on a colonization mission and this was his life's work. (R. 406–407.)

Recross-examination (R. Vol. 3, pp. 407–414):

From his knowledge in crossing back and forth over the San Juan and from the time he went down to see it and to get water, he would say the average depth of the water at those places would be from two to four feet.

He did not attempt to ford the stream during high water. The high water occurs generally about the first of May and extends to about June first, and then it recedes quite rapidly and the high-water season is passed about July and it gets lower from then on. (R. 407–408.)

He did not attempt to cross the San Juan River during high-water season either on foot or on horseback but the Navajos would jump into it at any time. He hasn't engaged in any such exploits. The times he has forded it has been practically the low-water season. The depths he gave to the Special Master were the average depths as he found them. (R. 409.)

He saw the river every year during the forty years he lived at Bluff and he lived right near the river. (R. 409–410.)

The river varies so; some places it is scattered out wide and other places it is confined in a narrow channel, and you couldn't hardly take a guess at it, but wherever he has forded it and the river is fairly well confined, it has been from two to four feet. (R. 410.)

During the forty years he lived there he has forded the river many times during low water some years. He doesn't suppose there was a year that he lived there that he did not ford the river. He has gone over the river on horseback where there were wide stretches up and down for a mile or two near Bluff where the river spreads out. Some places it is five hundred feet wide and has occurred since he went to Bluff. At these wide places where he has forded the river there were times when he did not go through water that was two or three feet deep. It has been spread out wide enough so that it wouldn't be that deep, but it would be on a ford. (R. 411–412.) The ford wasn't on the shallowest place as it is shallower where it spreads out and they usually didn't try to ford there on account of the quicksand. He couldn't tell what is the shallowest water he has ever forded when he has gone across the San Juan. (R. 412.) He has forded it sometimes when it came up just about to the horse's knees or about two feet high, but that is not the lowest he has ever seen it. (R. 412–413.)

Sometimes when the river is scattered all out over there it would be very shallow in some places, and when he crossed the channel here and there it would be deeper. Water in channel not always two or more feet deep, except on any regular ford. (R. 413–414.)

Further examination (R. Vol. 3, pp. 414–416):

He was one of the first settlers at Bluff and there is an old Indian trail which leads along the north side of the San Juan River but it was a long distance from the river. It would be over one hundred miles. (R. 414.) When he went to Bluff he didn't follow that trail as he went into Arizona and there was an old road there. From there he left the road and struck northeast on an Indian trail on the south side of the San Juan River; went through the Navajo reservation and crossed the San Juan River near Bluff.

Tuba City, Arizona, is one hundred miles from the San Juan River and as they came northeast they were coming toward the river but was a considerable distance from the river and on the first trip he didn't see the river until he got to Bluff. (R. 415–416.)

At that time the Indians were making use of boats to cross the river. They had little rude canoes but he saw no Indians going up or down the river.

Recross-examination (R. Vol. 3, pp. 416–420):

When he first arrived the Indians had some very rude canoes. They would hollow out some logs and they would sometimes tie logs together and make a rude raft to take their wool and skins across, and if they did not have anything to trade they would jump in and go across any season of the year and they still do the same way. The reservation is right across the river from Bluff. Navajos would tie their canoes up to bank and go up to store and trade. They would go across the river to their homes; the reservation is right across the river from Bluff.

Not a reservation proper, there when he arrived originally, but about thirty-five, maybe forty years ago, they passed a resolution in Congress permitting them to use the country between their line—the Arizona line and the San Juan River—on account of the scarcity of water. They moved in there. In fact, they claim that country. Since that time their journey has been from reservation to nearest trading post, and back.

When he first arrived there he doesn't know of any Indians going down river, if they did. They would cross and do their trading and go right back home; they may have towed a boat upstream for a short distance so as to get the benefit of the current, something like that; he never knew of them using the river to go up and down. (R. 417–418.)

There was some trapping on the San Juan River and he recalls the name of one trapper, Peter Shurts. He didn't have any cabin; just a tent, and it was located at the mouth of Montezuma wash fifteen to eighteen miles east of Bluff. He doesn't believe he came down the river after Bluff was established. He moved on up. (R. 418.) He doesn't remember any trappers down the river from Bluff, and there were very few fur-bearing animals. The fur-bearing animals were mostly up above Bluff. He believes the trappers had their boats, but when they came down to Bluff he believes they would take their burros and come that way.

Above Bluff the country is very level and the river has very little fall. The river is not now more or less confined above Bluff. (R. 419.)

The trappers didn't come down there in those early days; they took the furs out the other way; took them out toward Mancos. (R. 419–420.)

He would see the boats at their camps where they could. He doesn't remember having seen their boats at Bluff and would not say whether he has or not. (R. 420.)

Recalled (R. Vol. 3, pp. 577–578):

He believes he has lived longer at Bluff than any witness who has testified.

Bluff has had a more or less steady decline from the time they first settled there. (R. 578.)

At the present time he believes the population is a little less than one hundred. When he first went in there there were about two hundred but they didn't all stay in Bluff. They came in the [wagon] train.

He believes there were about forty-five men but he doesn't know how many women and children stayed. The largest number in the town of Bluff between the time he got there and the present time is between one hundred fifty and two hundred. It was soon after they landed there. (R. 577–578.) Those that did not stay at Bluff; a great many of them didn't intend to stay on the river, at all; they took advantage of the company coming through there, thinking they had a nearer route from Nevada and around the country through to Colorado; some of the settlers went on to Arizona that same spring he got in there. (R. 578.)

JOHN ADAMS

For Complainant

(Record, vol. 3, pp. 421–428)

He resides at Blanding, Utah, age 63 years, sheepman. Went to San Juan County, landed on the San Juan River about April 1, 1882. He was first engaged in the cattle business and ranged stock between Bluff, Utah, and the Colorado River, and covered practically all of the country between the 110th meridian and the Colorado River, north of the San Juan as far as the Grand.

The country is rough, broken, desolate and barren. (R. 421–422.)

Has been along the San Juan River on the north bank from Bluff to the Colorado River and is familiar with the character of the river and the stream bed. At Bluff the river bed is wide and contains considerable quicksand and is not suitable for fording. Fords cross on the gravel bars except where bed rock is exposed in the river bed. The stream is full of moving, shifting sand which forms side and cross bars. Through the canyons the stream has a rapid fall and forms rapids, and boulders falling from the cliffs form obstructions in the channel. The river bed is very rough coming through the canyons. Sand does not collect in the canyons where the rapids form but in the broad stretches of river where the fall is low. The sand is continually shifting and moving in the bed of the river. (R. 423–425.)

Has driven cattle across the San Juan River at the mouth of Comb Wash. (R. 425–426.)

The river channel has changed considerably since he first saw it. At Bluff, when he first got there, the river channel was narrow and the banks covered with willows and cane brake. The river channel and bed at Bluff now is half a mile or more wide.

He has seen the river when it was entirely dry on two different occasions and has seen it at one point where you could see the rock bottom all the way across; doesn't think water was over ten inches

deep at that point. He has seen it that shallow on other occasions.

In the early days he obtained supplies from Durango, Colorado. No articles or merchandise were sent out, cattle were driven out to Durango and Mancos. Never got any supplies into Bluff by way of the river and did not know of any one else getting them that way. He never knew of Indians using the river for trading purposes, only to cross it. (R. 426–428.)

Cross-examination (R. Vol. 3, pp. 429–437):

He doesn't know of any markets to speak of on the San Juan River above or below Bluff. There are some Indian trading posts below.

He testified to two occasions when the river was dry at Bluff.

There was on the river a place where he could see rocks clear across, this was at a different time than when the river went dry, about December. This was at Clay Hill Crossing, about seventy-five miles down the river from Bluff. Part of the river was frozen over, possibly four or five rods that was not frozen; could not see under the ice on the sides but doesn't think there was any water under it. He was on horseback. The water in the stream came possibly a little above the horse's ankles upon fording. Such a condition was not unusual at that time of year. (R. 429–432.) He could see rocks clear across; some of them sticking out of the water. Not an unusual sight at that time. (R. 433.)

He believes the horse would perhaps go on the ice a couple or three rods on each side. (R. 433.) He is just making an estimate of the conditions and he is basing his estimate on the appearance of the rocks being exposed. (R. 434.) At this time he has no recollection of seeing any such condition on any other occasion although he might have done. When he was looking after cattle if there was any chance to get to the river he would go and would follow up and down the river several times each year. (R. 435.)

The bluffs in places are above the river one thousand feet, the river being reached at many points by trails leading down washes. Sometimes they go from the high land and at others you climb up over the rocks and down the best way you can. There are no roads in the region as distinguished from trails. (R. 436–437.)

Redirect examination (R. Vol. 3, p. 437):

He has hauled and packed provisions from Bluff down to the placer mines at Cedar Ridge, about fifty or sixty miles above the mouth of the San Juan River. Supplies were carried on pack animals principally.

Recross-examination (R. Vol. 3, p. 438):

There is a road part of the way down the river, then only a trail. The placer mine could be reached practically only by this method.

The road and trail spoken of are on the north side of the river. The road from Bluff to Mexican Hat leads to within about ten miles of the mine.

The mine is located on the map as being about ten miles northeast of Goodrich at the end of Cedar Ridge. (R. 439–440.)

JENS NIELSEN

For Complainant

(Record vol. 3, pp. 441–460)

He resides at Blanding, Utah, and is 66 years of age. He is a farmer and stock raiser. He has lived in Blanding and vicinity since the spring of 1880 and is acquainted with land between the San Juan and Colorado Rivers, west of Bluff. The country is rough, barren and desolate. (R. 440–441.)

When he first went into the San Juan country, supplies were brought in by wagon and pack animals from Santa Fe, New Mexico and Alamosa, Colorado, and later on from Durango, Colorado, and Thompson, Utah. (R. 441.)

He saw boats on the San Juan River in 1890 that came down the river from Farmington, New Mexico, and went on down to Mexican Hat. Boats were carrying food supplies for miners and prospectors who were operating there. There were no regular supply boats into Bluff—just used for individual prospectors. Boats never went back up the river. (R. 442–443.) They couldn't get back up, had no way of pulling them back; high water took them down, they couldn't get back up without being towed up. (R. 443.)

He freighted merchandise into Bluff and to Moab from Thompson Springs, Utah, and from Durango, Colorado, by team and wagon for many years. He also freighted supplies down to the placer mine below Goodrich on the San Juan River. He believes the placer mines are about twenty miles up the river from the mouth of the San Juan River but had never been down to the mouth of the San Juan River.

He has freighted down Moonlight Canyon to Nokai and to about three miles the other side of Nokai where the mines were. (R. 444.) The road taken went to about five miles below Bluff, where the San Juan River was crossed and went over on the south side.

Indians used boats on the river for crossing back and forth but did not run up and down the river or use it as a means of transportation other than for crossing.

He saw the San Juan when it was perfectly dry in 1890 except for a few water holes along it. He has seen the river quite so low at other times. (R. 445.)

He has crossed the river and forded it when the water was not more than a foot deep, the crossing being made at Bluff. He has also crossed the river by fording at Sand Island Flat, about five miles below Bluff at the mouth of Comb Wash where Chinle Wash comes into the San Juan River. During the months of July, August, September, November, and December of different years, and

has crossed the river at the same points with freight wagons. (R. 445–446.) The average water at the fords was two to three feet deep; sometimes lower, sometimes higher. The lowest he has ever seen the water is about a foot deep. The river is variable as to depth. Conditions changed since 1880, in this respect. There were big flats and bottoms all along the river, and it has changed; those bottoms are all washed away. The river is over to one side one day and over somewhere else the next day; it is quicksandy formation; when the water hits the quicksand it melts it; when the water is real high, it tears right in and washes out a whole bottom; practically all the land that was there when they first went there has been changed and washed out, and new sediment formed in the place of it.

He helped in the attempt to control the river by building riprap dikes along the bank and filling the same with rock.

We would riprap the banks; that is the only bottom on the San Juan River as he knows of, where Bluff is located now, that has not been moved with the high water and the quicksand; they used to riprap there and change the river and put it over on the other side to hold their farming land from washing away.

After you get down below Bluff three or four miles, the country has been washed away; the place they call Sand Island flats, a mile or two wide, that has all been washed out.

After you get below there the country boxes in; there isn't much bottom land from there on down until you get way down, about seventy-five miles, only just little bottoms here and there; it boxes in; there are not very big bottoms; the canyon boxes in there. (R. 448.)

At one time they put in a dam across the river and turned it into another course altogether. This was about a mile above Bluff. (R. 448.)

When the river channel enters the canyon the bed is washed clear of sand and has a rock bottom with big rocks scattered over the bed. There are bad rapids in places. (R. 449.)

Cross-examination (R. Vol. 3, p. 449–459):

There is only one place below Chinle Creek where there is any great amount of bottom land but there are bottoms occasionally on the way down to where the San Juan enters the Colorado River. The biggest bottoms are from Bluff upstream. (R. 449.)

From Chinle Creek down the channel is confined. There is a very different situation from Chinle Creek up. From Bluff on down about five miles the river spread all over and washed out the bottoms but from there on down it was pretty well confined and that is the situation to-day. The condition has changed a great deal since he first saw the river in 1880 up around Bluff.

The area that the river spreads a good deal is from Bluff down to Sand Island. This is where the sand occurs. The channel of the river was not

now confined to the same stretch as it is now. (R. 450.)

He saw the river when it was dry, he believes, in 1890 and he recalls one occasion when he crossed at Bluff when it was about one foot deep. Another occasion when he crossed at Sand Island about five miles below Bluff there was about a foot at the lowest. At extremely low-water mark when it was as shallow as that there, it was maybe just on one occasion that he saw it. He also saw it on another occasion just above Chinle Creek when it was about one foot deep. (R. 451.) These minimum depths were during the lowest water season and he has never observed any similar depths at any other points on the river and they cover the period from 1880 when he first saw the river down to date. (R. 452.) Depth at Chinle Creek for the 40 years has been two or three feet at low water. (R. 452.)

He hasn't been there every year; just occasionally and for the last twenty-three years he hasn't been on the river. For the twenty odd years before that he wasn't on the river every day but was where he could see it occasionally up and down. Sometimes the average depth of the San Juan River would be two or three feet. Sometimes it would be less and sometimes more. (R. 453.) Depth would average two or three feet where the river is confined together; but in other places it floods all over, may be half a mile wide, and it wouldn't be so deep there. But where you get the river together in its

natural channel, it would average two or three feet deep; from one to three feet deep. (R. 454.) He is speaking of the low water season in giving the average of from one to three feet deep. (R. 454.)

If the river were confined to a narrower channel by riprapping, the water in the channel would be deeper than it is now in the ordinary channel. He has taken part with some success, in the enterprise looking toward confining the channel for the protection of the lands by riprapping. (R. 456.) Expense of work pretty heavy. Probably a hundred dollars a rod; that is, in places; where you change the current altogether it would cost that much. They were trying to make the river run straight. Could put it in pretty good shape for $2,000 or $3,000, but you have to keep it up one year after another; it washes out. (R. 456-457.)

He knows of two or three boats that have gone down stream from Farmington past Bluff and on down to Mexican Hat and down stream to where the placer locations were. The men stopped and got off at Bluff as they came down. He believes it was in 1890 but he never tried to remember any dates and he doesn't know how many men were in the first party. He believes there were two or three men in the one boat and they just had their camp outfit and grub to last the two or three months. He didn't see any lumber but he saw the one boat he has been referring to.

It was a small boat about fifteen feet long and four or five feet wide.

He believes it carried the same kind of things that he carried in his freight wagon, but he couldn't say what time of the year it was. He believes it was summer time or late in the fall. He has heard that there were others went down but he never saw them. (R. 457-459.)

Redirect examination (R. Vol. 3, pp. 459):

He has been at Mexican Hat recently and there is a store and five or six or seven people. Mexican Hat and Goodrich are the same thing. There are no other towns west of Bluff or any other families living west of Bluff except at Mexican Hat. (R. 459.)

Recross-examination (R. Vol. 3, pp. 460):

The stores furnished boats to ferry the Indians across the river at Bluff and he doesn't believe the Indians have boats of their own. They would cross anywhere at Bluff for about a mile. There wasn't any ford for the boats. The Indians would bring their supplies across in the boats, such as flour, bacon, and things they use and they would bring the things they sold, blankets and so forth, across in boats. Sometimes they would have trouble getting across when the river was high and sometimes they didn't. Sometimes with his freighting trips he would have trouble and sometimes he wouldn't. (R. 460.)

Recalled (R. Vol. 3, pp. 576):

The low water testified to in former examination was in 1893. The summer the river went dry rode

from Bluff City to Fruitland on horseback. (R. 576.)

A. L. RAPLEE

For Complainant

(Record vol. 3, pp. 461–490)

He resides at Bluff, Utah. He is seventy-five years old and is a miner and driller. He has lived in Bluff and vicinity since 1893.

He has used a boat on the San Juan River many times. For about three years he crossed the river every day on a boat. The boat was used to cross the river from camp to a placer mine at Mexican Hat.

Equipment in the placer mine consisted of water-wheel, sluice boxes and copper plates, the equipment being brought down to Mexican Hat from Rico, Colorado, by team and wagon. (R. 461–463.) He spent three years operating a placer mine and supplies were freighted in from Bluff and Durango both by wagon and by boat. Lumber especially was taken down to the mine by boat. He never took a boat back up stream, it was too hard work. The boats used for freighting lumber were about eighteen feet long with a four and one-half foot beam, flat bottom, and drew probably six inches of water. Trips were made during all seasons of the year. Trips were made during the high water period mostly; made a few trips at the low stage but found it was too much work. The claims were on the bed of the river. (R. 464–465.)

He made boating trips at all seasons of the year. (R. 465.) Made some at low water, but it was too much work. (R. 466.)

The water was usually high in the spring along about June and in September and in October floods occurred that caused high water. It generally took one day to make the trip from Bluff to Mexican Hat, by boat. (R. 466.)

Trouble with sand bars was encountered during the month of June unless the water was very high. Sand bars were not frequent during ordinary high water, occurring possibly fifteen or twenty times on the trip. Trouble with rocks was also encountered, the boat drifting into the rocks because of the swiftness of the stream, and ordinarily damaging the boat. (R. 466–467.) Hit sand bars fifteen or twenty times in the month of June. The boat would drift in on the rocks, and you couldn't help yourself sometimes, and generally have a smash-up then. (R. 467.)

During low water in August and other low-water months, more difficulties were encountered; rocks are worse and sand bars more frequent, requiring about fifteen hours to make the trip of twenty-five miles.

The water is low then, and you are running on to the rocks all the time, got to pry it off the rocks and have considerable trouble. The sand is worse then on account of being very little water on top of the sand. (R. 468.)

Most of the supplies were boated down the river from Bluff to the mining camps during the first year. There were other mines in the vicinity at the same time, probably one hundred fifty men working on the river. After wagon road was built the supplies were hauled there by wagon.

Very little machinery was used in connection with placer operations. The wheel for elevating the water constituted the heaviest equipment. Two of the placer operators had steel boilers which were taken in by wagon. Casing and drilling machinery necessary in operations for oil drilling were taken into the country by wagon during the years between 1909 and 1918.

One of the boilers brought in was never used at all. The mines are still in operation. The miners come down sometimes during the winter months and mine some.

He has been engaged in the oil business himself about twenty-five miles west of Bluff, right on the San Juan River. He has two wells right at the edge of the water. He did his drilling under the placer law. (R. 470–471.)

All of (equipment) it was taken in by wagon; they had got the road built in by that time and it was all brought down by wagon. (R. 471.)

Cross-examination (R. Vol. 3 pp. 472–482):

Supplies brought down the river by boat before the road was built, consisted of foodstuff, shovels, picks, drills, lumber, and some powder. The lum-

ber was used for building sluice boxes and the water wheel. The placers were operated about three years before the road was built from Bluff to Mexican Hat, during which years supplies were brought by wagon to Bluff and boated down the river. (R. 472–473.)

There were probably one hundred fifty men operating on the river at that time and he had probably eight or ten employees and there was considerable tonnage to keep all of them going and a great deal of traffic. Lots of the other outfits had boats similar to the ones he used. (R. 473–474.)

Several of the other placer operators had and used boats on the river, these boats being built at Bluff, Utah, and were probably fifteen or twenty in number. About two trips a month were made for supplies. One boat would haul about a thousand pounds. (R. 474–475.) He would make about twenty-four trips a year and probably carried twenty-four thousand pounds per year. For a period of three years there would be about seventy-odd thousand pounds of freight that he carried. (R. 475–476.)

A number of boats came down the river from New Mexico and Colorado to the mining camp, carrying men and supplies. Some of the boats were built in Durango and shipped all the way down the river. (R. 476.) He believes that there were twenty or thirty of them came down past Bluff by boat, probably more. The placer claims extended

down the river about, say, seventy-five miles below his camp. These men would need a similar amount of supplies of various kinds as he needed in his operations. (R. 476-477.) The other placer claims were all about the same size.

When he speaks of two hundred men working on the placer claims it wasn't the same two hundred, as they would come and go. They would come down and work through the winter to get out of the snow and as soon as it was warm in the spring they would go back to the mountains.

There is a tremendous tonnage carried in the sands of the San Juan that have gold values. There is difficulty in solving the process problem, as the gold is very fine. If there was a better process perfected for separating the gold from the sands there would be tremendous values taken from them. (R. 477-479.)

He believes he has had five oil permits on the river. They are located from the mouth of Lions Creek down to where the bridge goes across the San Juan. It is down the river about twenty miles west from Chinle Creek. There are a great number of other oil structures on the San Juan besides those covered by his permit. Some are ten or twelve miles back from the river and there are others on the river bed. (R. 480.) There is one joins his ground on the east and one on the west and there are some others on downstream and there are some big oil seeps in the canyon. The oil

structures extend down as far as Slickhorn Canyon. It would be about twenty miles from the confluence. (R. 481.)

Slickhorn is a steep canyon and there have been a number of oil locations made along there and a well was drilled there about twenty years ago.

The structures extend all along the river bed substantially to the confluence of the Colorado and also south and north of the San Juan country. (R. 482.)

Redirect examination (R. Vol. 3, pp. 483–487):

Trouble in running the water wheel was had at different seasons of the year due to low water. He remembers seeing the San Juan River dry but does not recall the exact year. He remembers the time the river was dry and the day before a big flood came. He had ridden horseback up the channel of the river six or seven miles from Bluff and another person, a brother-in-law of Mr. Zahn, had ridden up the river from Zahn's camp, a point about seventy-five miles below. (R. 483–484.)

The next day a flood came down the river, washing away the water wheel at the placer mine. In 1911 he was located at Mexican Hat, back about fifty feet from the river, and his house was washed away by another flood. It was a substantial rock house and cost about $7,000.00. The water absolutely obliterated the building. (R. 485.)

No heavy machinery was taken down the river in boats because of the fact that boats wouldn't float.

If more than six hundred pounds were loaded on the boat they had to be led around some of the rapids because of the hazard. The boats were propelled mostly by leading them around and sometimes they could row but in rough water they would pole them. (R. 486–487.)

Recross-examination (R. Vol. 3, pp. 487–488):

The river was dry for a period of about three weeks. There were no pools along the bed, wasn't a drop of water except where the Indians had dug for it to water their ponies. (R. 487.)

The water wheel was taken down on a wagon.

When he was working the placer claims there were two men besides himself living right at the mine in a little old rock house. The other placer miners living farther down the river lived under the rim rock and they did not have any houses and lived in tents. (R. 488.)

The length of a day in boating from Bluff to Mexican Hat, a distance of twenty-five miles, during high water in June, is fixed at ten hours. In low water the time required to boat the same distance is fixed at fifteen hours. (R. 489–490.)

WILLIAM J. WALKER

For Complainant

(Record vol. 3, pp. 490–495)

He resides at Kirtland, New Mexico. He is 55 years of age and is a merchant. Kirtland is located on the San Juan River. He has lived there

since June, 1896. The country is used for farming and stock raising, farm crops being raised by irrigation water at the present time taken from the Animus River. Formerly it had been taken from the San Juan River. In 1902 the river was so dry that it was necessary to build a dam in order to get water to their crops. The period of dryness lasted about two weeks and was during the month of August. This experience occurred in the valley of Fruitland. Kirtland, he would judge, is in the neighborhood of fifty miles above Bluff. (R. 490–492.)

He believes there are no perennial streams running into the San Juan River between Fruitland and Chinle Creek.

Only small skiffs or boats are used on the San Juan River; in 1911 he had such a small boat, similar to those owned by other traders, that he used to row supplies across the river.

He has done freighting in the country adjacent to Fruitland but never had the freight come in by way of the San Juan River, nor did he freight it out by way of the river. Supplies into Fruitland are brought from Farmington and Gallup, New Mexico, by wagon. (R. 492–493.)

Cross-examination (R. Vol. 3, pp. 493–495):

Several skiffs were used for trading with the Indians back and forth across the river. The Indians usually brought pelts across the river and traded for foodstuffs. The skiffs were eight or ten feet long, four feet wide, flat bottoms. (R.

495.) On one occasion put in dam to divert water for irrigation. Usually when they had a little higher water, why, it would cut the channel in the river, and knock down their ditches; they didn't have ditches large enough to draw the suction through, so they had to clean that bar out and divert the river to get it down there and get it in their ditch. The water was cut down to a lower level so it wouldn't flow into ditches without some little dam. The scarcity of water was one of reasons for dam; it dried up so it didn't run from one pool to the other; it formed pools, but so dry it didn't run from one to the other. (R. 494.)

He believes at this time the San Juan River carried less water than at any other time. The La Plata River comes in above Fruitland. (R. 495.)

CORD C. BOWEN

For Complainant

(Record vol. 3, pp. 495–511)

He resides at Goodrich, Utah, and is a merchant. He is running a trading post and has lived in the San Juan country since 1878. He has not lived there continuously since that time. He is familiar with the San Juan River from Bloomfield, New Mexico, to Zahn's Canyon, a distance of possibly fifteen or twenty miles below Mexican Hat.

Goodrich, Utah, is about two and one-half miles below Mexican Hat on the San Juan River. (R. 495–496.)

He doesn't know of the Indians ever having used the San Juan River for trade or travel. He has not used the river for trade or travel himself and does not know of any navigation whatever on it. He doesn't maintain a ferry himself in connection with his trading post. He saw a boat on the river last winter [1928] and a boat when he was a boy about eight years old, forty-five years ago. He has never used the river for shipping supplies in or out from his trading post at Goodrich. Most of his supplies are brought in from Bluff, Utah, by wagon, also from Cortez and Gallup, New Mexico, and Durango, Colorado. He has never been on the river in a boat—just crossed back and forth. (R. 497.)

The sand bars in the river are continually changing from place to place, shifting all the time.

Jewett, New Mexico, is the place where he boated across the river.

He has crossed the river afoot, on horseback, in wagon, and every other way except in a car. He doesn't know how many different places he has crossed it but has crossed it all the way from Bloomfield down to Mexican Hat. (R. 498.) He has crossed the river on foot between Bluff and Mexican Hat; right at Mexican Hat, and right at the store. (R. 499.)

The highest water in his memory, was on the 29th of September, 1927, when the water was thirty-

three feet deep. High water occurs usually in May and June, then in September and October, occasionally in August.

The only people who live at Mexican Hat at the present time is he and his family and another family about one mile and a half above them and there are no other people living in that country between the Colorado River and the San Juan that he knows of. (R. 499–450.)

During the flood period the water carries considerable driftwood. The flood of September, 1927, down Gypsum Creek, brought down so much débris that it practically dammed the San Juan River.

Two years ago in September river raised seven feet in one hour, and something like two weeks ago they had a flood there twenty-eight feet, it raised five feet there in twenty-five minutes at that time. (R. 500,)

Good deal of débris comes down that river; it is just a solid stream of silt and mud and gravel. (R. 500.)

He has observed lots of sand waves upon the river as there are always sand waves when there is a flood or any high water at all. These sand waves get up to a height of six feet, probably above the level of the water.

He has never engaged in placer mining. There is only one road leading from Mexican Hat and Goodrich. It passes the store and crosses the river below the store (R. 501), north side of river.

He does not know when bridge was built; he wasn't down there when the bridge was built. (R. 501.)

Cross-examination (R. Vol. 3, pp. 502–511):

There is a distinction between high water and flood water. High water occurs in the spring of the year, usually, and has a natural rise and fall; flood waters occur usually in the late summer from cloud-bursts and heavy rains. The rise of thirty-five feet referred to in September, 1927, was caused by a cloud-burst.

He has had occasion to observe waters in the river because of the fact that he hauls water from the river to his house at Mexican Hat, a distance of about two hundred yards, and has taken gauge readings for the government on the river for the past two years. (R. 502–503.)

He has lived about two and one-half years at Goodrich. Before that he lived in Montezuma Valley at Cortez, Colorado. He moved from Animus City, Colorado, to San Juan County in 1878 and stayed in San Juan County about twenty-one years and lived at Jewett right on the river during that time. Jewett is about eighty miles up the river from Bluff, Utah, in San Juan County. (R. 503–505.)

He was first in San Juan County, Utah, about twenty-five years ago, when he freighted in there from Delores. He freighted from Bluff and the oil fields below Bluff City.

He doesn't believe there has been a year since he left Jewett, New Mexico, that he hasn't been in San Juan County. He went after stock or on a round-up and he would occasionally cross the San Juan River either on the Navajo reservation, in Utah, Arizona, New Mexico, both above and below the four corners. (R. 505–506.)

He would probably have occasion to go down around the San Juan River in Utah probably once a year. It would be different times of the year, not always in the winter or summer. He would always cross the river unless he was going out on the reservation after stock.

He believes he has been over on the Navajo Reservation three different times, and each time crossed the river going and coming on horseback and not on the bridge. (R. 507–508.)

He has travelled over the old road from Cortez to Bluff many times each year before he moved to Mexican Hat. The old road is right along the side of the river from McElmo Creek to Bluff, a distance of about twenty-five miles. He crossed the river at least once a year on horseback and has been over the road at least twenty times. The road was discernible at all times and he used this road for freighting in and out of Bluff.

At places where the road crossed the low lands where the water would overflow, the tracks might be obliterated.

Aside from the three times he went over to the Navajo reservation and the twenty freighting trips

along the old road that was close to the river he doesn't believe he had any other experience with the river until two and one-half years ago when he started his trading post. During that time he doesn't believe he crossed the river at any place except the one place by Mexican Hat and Goodrich. There were two fords right there by the store. (R. 509–511.)

JOHN BELL

For Complainant

(Record, vol. 3, pp. 512–514)

He is seventy-four years old, resides about seventeen miles above Durango on the Rio Grande River, and is a contractor for the American Smelting and Refining Company. He has been in the San Juan River country around Bowen's Ferry, Fruitland, and Pegosa Springs, and at what he calls Aztec Crossing and different points innumerable times. (R. 511–512.)

He recalls the flood of 1884. He had built a bridge across the Aztec in 1883; in the spring of 1884 the flood came and he was called on to rebuild the bridge and try to save it but was unable to do so, the water at that time rising about two to three feet above the known high-water mark. The Animus River, a tributary to the San Juan, is a perennial stream entering the San Juan below Farmington sixteen or eighteen miles he believes. (R. 512–513.)

He has forded the San Juan River at Fruitland, but the water is not very deep, possibly to the horse's knees. The ford crossing usually is in channels from two inches to eighteen inches deep. (R. 514.)

HARRY C. BALDWIN

For Complainant

(Record, vol. 3, pp. 514–517)

He resides at Farmington, New Mexico, and is 46 years of age. He operated a store at Hogback, twenty-four miles below Farmington and between eighty and ninety miles above Bluff, for twenty years, having located there in 1895. He made one trip to Bluff, Utah. The Hogback store is on the San Juan River and supplies were freighted in from Durango, Colorado, and Farmington, Colorado, overland. He never had any freight come in by way of the San Juan River. He traded with the Indians at Hogback for twenty years.

He had a boat that belong to the Indian Rights Association that he used for a ferryboat. (R. 515–516.) He never knew of the Indians having any boats and using the river.

He is not familiar with the creeks and washes that run into the San Juan River between Farmington and Bluff except Choco and this stream doesn't run the year round. The only stream that runs between the two points the year round is the Animus. (R. 516–517.)

ALBERT P. BLAKE

For Complainant

(Record vol. 3, pp. 517–522)

He resides at Farmington, New Mexico, and is 49 years of age. As his professions he has followed Indian trading, farming, and merchanting.

He is familiar with the San Juan River at Farmington [New Mexico] and has made one trip down the river to Bluff and Goodrich. At Farmington the San Juan River is sometimes real high and other times real low and when it is low there is very little water in the river. (R. 517–518.)

He has carried on trade with the Indians but has never known them to use boats on the river.

He has crossed the river by fording with a wagon, by wading it, and crossed it at one time dry shod. These crossings were made about one hundred fifty miles above Bluff, Utah. (R. 518–519.)

He obtained supplies from Farmington and from Gallup, New Mexico. Supplies were never brought in or sent out by a boat on the San Juan River, and he has never operated a boat on the San Juan River. (R. 519–520.)

Cross-examination (R. vol. 3, pp. 520–522):

On his trip from Farmington to Bluff and Goodrich he went down the river overland, the road being right close to the river, at no place was the road over two miles from the river. He can not give the year in which he crossed the San Juan River dry shod. (R. 521.)

He never knew of Indians using boats in any way either for crossing the river or for navigation up and down the river. He went to Bluff and Goodrich, Utah, overland by road which was not over two miles from the river at the farthest point.

Further examination (R. Vol. 3, pp. 522–523):

He began business as a trader in 1910 and continued until 1919, handling general merchandise for the Indians.

In hauling supplies he used wagons and had he been given an order to take supplies to the placer miners he would have taken them down the river in a wagon; down the road along the river bank. He means down the bank of the river and there is a road all the way on the north bank that he believes has been there since 1909. He doesn't know how long it has been built but he knows it is there as he saw it. At the time he had his store there were no miners that he knew of in the country. (R. 522–523.)

He operated a general merchandise store, using wagons for transportation purposes, and would have taken supplies down the river by wagon had he been given an order. (R. 523.)

GEORGE E. BLAKE

For Complainant

(Record vol. 3, pp. 524–526)

He resides at Farmington, New Mexico, and is a merchant.

He is 44 years old, and is a brother of Albert P. Blake. He is right familiar with the San Juan River between Shiprock and Largo, but has never been to Bluff. He got supplies by the D. & R. G. Railroad.

He trades with the Indians but does not know of Indians using boats on the river. (R. 524–526.)

Cross-examination (R. Vol. 3, p. 526):

Rails run right into Farmington and he never selected a water route in preference to the rails.

JACK MARTIN

For Complainant

(Record, vol. 3, pp. 526–532)

He resides at Farmington, New Mexico, and is 76 years old.

He moved into Farmington in 1890. R. 526–527.

He is familiar with the San Juan River from Pine River Largo down to Cudahi, about eighteen miles below Shiprock, also the vicinity of Mexican Hat, having been with the Reclamation Service. In 1916 he left Shiprock with Mr. Smith and Reclamation party. (R. 528–529.) He crossed the river and travelled by team overland to Monumental Valley. He crossed the San Juan River at Bloomfield on a boat once, but did not attempt a boat down the river. He has never heard of Indians using boats on the river in the vicinity of Farmington.

Mr. Smith was taking elevations for the Reclamation Service to see how high he could get the water

out of the San Juan River and how much land it would cover. He was also with Kenneth Sawyer up the river hunting dam and reservoir sites in the same work and for the same ditch or canal.

Further examination (R. Vol. 3, pp. 531):

The party was on the south side of the river going down to Mexican Hat on the Navajo Reservation and were attempting to lay out ditches through the reservation. They were not figuring on dam sites in this lower region but expected to put a dam site on the San Juan and Colorado. Mr. Smith told him that the project had been favorably reported and was one of the finest propositions that he had ever seen or been on with the government. (R. 531.)

Redirect examination (R. Vol. 3, p. 532):

This tract referred to is located on the Navajo reservation from east to west on the south side of the San Juan River and is part in New Mexico and part in Arizona and Utah, he doesn't know which; but there is a strip of Utah on the south side of the river. (R. 532.)

ORANGE J. CARSON

For Complainant

(Record, vol. 3, pp. 533–538)

He resides southeast of Farmington, New Mexico, and is forty-three years old. He is familiar with the San Juan River from Largo to Shiprock

and until the bridge was built, forded the river at Farmington. The bridge was built nine years ago. (R. 533–534.)

During the 1911 flood he was living about two miles north of the San Juan River between it and the Animus. The flood washed houses and farm crops away and some livestock.

Regular high water occurs from about May to the middle of June. The flood covered all the bottom land for probably one-half mile wide in places and maybe wider in some places. Rain water that causes trouble occurs the 20th of July until October nearly every year.

He has seen the San Juan River once when it was practically dry, about 1904. (R. 533–536.)

Cross-examination (R. Vol. 3, pp. 536–537):

There was only one big flood that he knows of in his experience with the river and that is the one he has mentioned and ordinarily there are about three heavy rains a year and during these periods the river rises some. (R. 536–537.)

WILLIAM BUTLER

For Complainant

(Record vol. 3, pp. 537–540)

He is 67 years of age and resides at Farmington, New Mexico. He has lived at Farmington, New Mexico, since 1901.

He has been down the San Juan River as far as the Four Corners.

The flood of 1911 destroyed houses, crops and fences in the vicinity of Farmington.

The San Juan River carries a great deal of silt and sand.

To his knowledge the Indians have not used boats on the river and he has never known of any navigation on the San Juan River except ferrying. (R. 537–540.)

Cross-examination (R. Vol. 3, pp. 540):

Ferry boats carry freight and passengers during the high-water season. (R. 450.)

PARLEY ROGERSON BUTT

For Complainant

(Record vol 3, pp. 541–565)

He resides at Dove Creek. He is 69 years of age and is a farmer and stock raiser; he has been familiar with the San Juan River for thirty years.

He lived in the San Juan country at Bluff, Utah, up until six years ago, when he moved into Colorado. He came into the San Juan country from Iron County, Utah, in 1879, with Kumen Jones and party. (R. 541–542.) They commenced preparing land for crops and cultivated farms.

In 1894 the flood waters of the San Juan River washed most of the farm lands away. They had spent hundreds of dollars to get the cottonwoods away for cultivation. He attempted to save lands by building riprap dykes along the river and filling in behind riprap with rocks. The riprapping was complete when the high waters came. (R. 543–544.)

He forded the river a number of times at Clay Hill, about fifty or sixty miles west of Bluff, and at Mexican Hat. Sometimes the water was so high that it would pretty near swim the horses, other times it would only come about to the horse's knees. Most of the crossings were made in the fall and winter and in cold weather the river could almost be waded. He has been overland between Bluff and the Colorado River several times.

He went down to Hole-in-the-Rock to help emigrants get into Bluff, Utah. (R. 544–546.) Hole-in-the-Rock is about seven miles above the mouth of the San Juan River on the Colorado River. Boats were built at the notch to ferry people across the Colorado River at that point. The lumber for building the ferrys was freighted to the Hole-in-the-Rock from Escalante, Utah, where it was cut and sawed. The road was prepared and the ferrys built on the second trip to the settlers when they moved from Iron County into Bluff. (R. 547–548.)

They were on the north side at that time; they hadn't crossed the river yet; they came south and east.

That was their second trip. They went back to Iron County, left there on the 14th of November, 1879, to retrace their steps to get back to the previous location, where they had located on the San Juan River, brought a big delegation to help settle on that rich soil, they call it. (R. 548.)

During the first trip the emigrants came into the San Juan country at Bluff after crossing the Colorado River at Lees Ferry. The first trip was a kind of prospect party to see whether it was fit for colonization scheme. They then swung back across near Moab and crossed the Green at the town now called Greenriver back to his old home. The second trip consisted of the colonizers and went to the Hole-in-the-Rock, crossed the Colorado River by ferry, and went to Bluff overland by team and wagon.

The rescue party left Bluff and travelled westward overland to the Colorado River opposite Hole-in-the-Rock. When the ferry was stolen at the Hole-in-the-Rock the emigrants forded the river. (R. 548–550.)

The emigrants constructed the road to the Hole-in-the-Rock and from the south side of the river to Bluff along the north side of the San Juan River. Horses, mules, and ox teams were used in drawing the wagons.

They ran cattle on the south side of the San Juan River between Bluff and Mexican Hat and sometimes crossed over to the north side.

They had considerable trouble with sand bars and quicksand in crossing the San Juan River, for where the river doesn't have much fall the channel changes with the different stages of the water and the sand bars shift their positions constantly. (R. 550–552.)

He never saw boats on the river except at the trading posts, where they were used for crossing back and forth. They butchered cattle that ranged around the San Juan River which drank water from it and they found from four to fourteen pounds of silt in their stomachs. It is sometimes necessary to pull hundreds of heads of stock out of the quicksand in the river. (R. 553–554.)

Storms cause rapid rise in the river, sometimes to the extent of causing a flood and washing away the banks. He has seen the river frozen over and had been in many sand storms along the river. Sand storms are frequent during the spring of the year, especially in May. (R. 554–555.)

Cross-examination (R. Vol. 3, pp. 555–560):

He forded the river hundreds of times, both when it was low and when it was rising. He saw the river frozen over many times where the water was quiet; the water doesn't freeze over the riffles. The first time he saw a flood in 1881–1882, the water covered the land knee deep to a horse. He moved away from Bluff in about 1902. There was a big flood just before he left and that is the reason that he moved. This was the biggest flood he ever saw. (R. 555–560.)

Redirect examination (R. Vol. 3, pp. 560):

When he first came into that country there were a few houses and dugouts at Moab. This was in the fall of 1879 that he went through there. Half

the settlers were living in log houses and underground cellars that they lived in for protection.

There was nothing but a ford across the Colorado River at Moab at that time. (R. 560.)

Further examination (R. Vol. 3, pp. 560–563):

He was one of the first settlers in the San Juan county outside of a few trappers who were already there. He has been more or less through the center and eastern portion of the county.

People have been coming in there to locate and they think the country is productive; good for chickens and milch cows.

A portion of the land down toward the Colorado River where the Colorado and the San Juan come together is just as solid as the walls of the room. There is a little brush and a few gravel mesas with a little grass growing on them, but they are narrow. (R. 560–561.) The soil on top of the uplands is just cobblestones.

There is a man out here now, Peter Shurts; they had been raised in southern Utah; they wrote to their friends to come up there and locate on the land, not to depend on the little mountain stream where they was fighting over a foot of water. That is what induced the people to come out; they thought he was truthful.

Hundreds of them took his word and came out and settled, tried to settle on the San Juan River

that hadn't been no more than located there until the high water come and washed all away.

Bluff was the first place he thought of settling on, at the mouth of Montezuma canyon; they had a little town there where Bill Hyde's parents lived; the water washed them away; washed the trading post away, all the land, and Bluff was a place the people settled to make a permanent home. No talk of gold when he got there, nor of oil. Has not seen any. (R. 562–563.)

Redirect examination (R. Vol. 3, pp. 563):

The productive part of that county is all east of a line running north and south through Bluff.

He has run cattle in the country west of there. There are no farms west or north. There was a man who raised a few watermelons and corn in Comb Wash that year, but sometimes water would go down there and swipe everything off. (R. 563.)

He doesn't know how many cattle would be run to an acre in the country. (R. 563.)

Further examination (R. Vol. 3, pp. 564):

The only thing land is fit for is for grazing country; not for agriculture, but sheep and cattle do very well. (R. 564.)

Redirect examination (R. Vol. 3, pp. 564–566):

Where the rivers come together there is nothing but red rock; only a few cobblestone mesas. South of Elk Mountain and all the mountains east of there has quite a lot of grazing land. Elk Moun-

tain is right north of Bluff City. In the country west of Bluff where they ran cattle and pasturage was found in the draws and on the sloping hills. South of Cedar Ridge there is some grass growing some years, some years it doesn't. There was more grass there than where they had been grazed in the summer. There was brush all over there. They call it Black brush and cattle do fairly well on it in a wet fall and so do sheep. (R. 564–565.)

They shipped their cattle to Denver mostly. They would generally drive them to Dolores, Colorado, on the D. & R. G. narrow gauge and some are loaded at Thompson Springs. Hundreds of thousands of sheep are loaded there on the standard-gauge railroad. (R. 565–566.)

C. CLINTON BURNHAM

For Complainant

(Record vol. 3, pp. 566–570)

He resides at Farmington, New Mexico. He is 54 years of age. He is a trader and has been in that business for about twelve years and prior to that time worked for wages and was a farmer on the San Juan River. He first went into the San Juan country in the early spring of 1881. The family settled at Fruitland, about twelve miles below Farmington on the San Juan River, and has been in that country ever since. (R. 566–567.)

He has been down the San Juan River as far as Bluff City and has had occasion to observe the

river during low water. He has also observed the river around Hogback, Farmington, and Shiprock when there was very little water. He has seen the river between Shiprock and Bluff when there wasn't any water in the bed except in holes and depressions and has seen it when it was quite high.

He has never traveled up and down the river in a boat but has helped ferry other people across with boats. Never to his knowldge has he seen Indians running boats up and down the river. (R. 566–570.)

Cross-examination (R. Vol. 3, pp. 569–570):

He can't fix the year when he saw the river dry but there was more than one year. The last time he remembers it was dry he believes was between 1898 and 1900 but he can't tell the date.

He made a trip from Fruitland to Bluff City and has been down there several times but he couldn't tell the time. He has been down by wagon road and went down horseback once with a pack outfit and followed the road part of the way. (R. 569–570.)

JAMES McEWAN

For Complainant

(Record vol. 3, pp. 571–576)

He resides at Dolores, Colorado, and is a cow man and a hay raiser. He has been on the San Juan River from Farmington up to Aztec and down as far as Comb Wash, fifteen miles below Bluff. He first came into the country in 1884.

He had some horses at Comb Wash and came over to sell them.

He has crossed the San Juan River below Bluff about fifteen miles when he went to trade horses with the Indians.

He has seen the San Juan River between Shiprock and Bluff City when it was dry except for a little seepage; could cross without wetting his feet. He believes he has also seen the river pretty low or dry on two or three occasions above Bluff and in the vicinity of Shiprock. He crossed the river at Shiprock for several years but he did not keep any date on it. He first came to Cortez in 1896 and had about eight dry years. (571–574.)

Cross-examination (R. Vol. 3, pp. 575):

He believes he has seen the river about dry below Shiprock. The farmers would take all the water out above but he can't fix the year. It was between 1896 and 1906 as he crossed it nearly every year. (R. 575.)

Redirect examination (R. Vol. 3, pp. 575–576):

He rode a saddle horse across Green River at Blake City and across the Grand River at Moab. (R. 575–576.)

GUY S. NEWKIRK

For Complainant

(Record, vol. 4, pp. 580–591)

He is a civil engineer, age 43, resides in Denver, Colorado. He graduated as a civil engineer from

the University of Colorado in 1912, and has followed his profession since that time. He was in the San Juan River country in Utah in 1923, surveying prospecting permits for the Midwest Oil Refining Company from the middle of March until about the first of September. Worked from Shiprock down to below Clay Hill, which is a little below the mouth of Moonlight Creek. Surveyed a strip of country between those points about ten miles on each side on the San Juan River. There were four or five men in the survey party. (R. 580–581.)

From Shiprock to Mexican Hat an automobile was used as a means of transportation, while from Mexican Hat west saddle horses were used. The party never used a boat on the river, even for crossing. The river was forded either on horseback or afoot when it was necessary to run the survey line back and forth across the river. The river was forded below Bluff at about the mouth of Chinle Creek, above Bluff, and somewhere near the mouth of Moonlight Creek. For about a week or ten days the river was crossed back and forth every day at the mouth of Chinle Creek on horseback, as the water was from one to two feet deep; no trouble was encountered with quicksand in crossing.

Quicksand occurs at various places in the river, and crossings were made in the riffles or on the gravel bars. They would pick out these places on foot mostly before they took the horses in.

The water is heavily laden with silt, and the horses wouldn't drink it if they could get water any place else. (R. 582–583.)

The country west of Bluff generally is barren and desolate. During the first of the summer it is necessary to carry food for the horses because it is so dry. Supplies were obtained at Bluff, Utah.

He crossed the river, he believes, a dozen times in the vicinity of Mexican Hat, and the water would be around two feet where they crossed. It was above Mexican Hat where he crossed, as there was a bridge near Mexican Hat, and he also crossed near Moonlight Creek, he believes. It was about the first part of May, and he made just one round trip at what he calls low water. He crossed on horseback, and the water would come up to the horses's belly. (R. 585.)

During the month of August there were heavy rains and cloudbursts, and floods were experienced on Moonlight Creek. The water would come up high in a few minutes and subside again in a few hours.

The channel of the San Juan River at Bluff, Utah, is about one-quarter of a mile wide. In the canyon below Chinle Creek the channel is only about fifty to one-hundred feet wide, more or less, in places.

The depth of the canyon is five hundred feet or more; the distance from rim to rim is one thousand feet. No supplies were taken by boats. (R. 585–587.)

Cross-examination (R. Vol. 4, pp. 587–588):

He was working on the section of the river from Chinle Creek on down in the latter part of June and the first part of July and was passing through in May, 1923. The work continued on until September and he left about the first week in September. He was on the north side in the spring and down around Zahn's Canyon in May and was in and out at different times during the summer. (R. 587.)

He was down on the section beginning at Chinle Creek during August and the expedition started from Shiprock, New Mexico, and the purpose was to survey sections on both sides of the river and to survey this ten-mile strip on both sides. He had horses. He doesn't know whether the country on both sides of the San Juan River had been winter-ranged before his arrival, although he knows that they run cattle in there at times. It doesn't begin to get green until usually late in the summer, July or August. (R. 588.)

Further examination (R. Vol. 4, p. 589):

The purpose of the survey was to stake out boundaries of oil prospecting permits but it didn't necessitate surveying the bed of the river.

Redirect examination (R. Vol 4, p. 589):

The permits were United States government permits and there was a government land survey through that country that established corners along each side but he doesn't know whether they ever put anything on the river bed or not. (R. 589.)

Recross examination (R. Vol 4., pp. 589–591):

He doesn't know whether the stream bed itself had been meandered, but the canyon on top had.

He examined the official plats before he started on his survey and as he remembers, there was a traverse made along the rim. (R. 589–590.)

FRANK H. HYDE

For Complainant

(Record vol. 4, pp. 591–663)

He resides at Salt Lake City and is 60 years old. He is a farmer and stock raiser and has lived in the San Juan country practically all of his life. He went there at about the age of 10 with his parents from Juab County, Utah, travelling with an outfit of six wagons and possibly a hundred head of horses, via Escalante and Hole-in-the-Rock. They crossed the Colorado River and then went on down the north side of the San Juan River to Bluff; then on up to Montezuma, about fifteen to seventeen miles above Bluff.

There were about ten or eleven families there at that time and a fort was built, or what they called a fort, log cabins in a square, and established a farming settlement. (R. 591–593.)

His father built a store and traded with the Indians, and he has worked as far back as he can remember.

At that time the river was confined to a permanent channel, willows and mulberry bushes growing on each side of the sloping banks. He could ride ponies across it most anywhere he came to it without fords.

His father put a water wheel on the river and raised the water out by means of the wheel for irrigation purposes. This was about fifteen miles above Bluff.

After the country was settled, livestock tramped down the grass and the timber was cut off the headwaters and the floods started coming and washed all the farm lands and improvements out. After that all but three families moved away. (R. 594–595.)

He was on the range from the time he went there as a boy. The summer range commences back forty or fifty miles from the river in the vicinity of Bluff Mountain; in the winter the stock drifts back into the sand flats nearer the river. (R. 595.)

He lived in Montezuma about three years, and his father then went down to the mouth of Chinle Wash, about nine miles below Bluff. Chinle Wash is on the one side of the river and the Comb Wash on the other. There he put up another store. His mother stayed at Montezuma. That was the year after the big flood. (R. 596–597.)

He never saw the Indians use boats.

His father established a cable ferry across the river at Chinle Creek. Because of the erosive ac-

tion of the water during storms and freshets and of the sands during the dry season the river channel has a tendency to fill with sand. Sand fills the channel of the river a foot or two and has a tendency to throw the heavy body of water and current against the banks at the sides. This undermines the banks and caves them in, filling the channel again with more sand and this throws the channel back to the other side, where the same process continues. Because of this erosive action the ferry-cable anchors were washed out and the ferry tipped over.

His father put in a cable boat ferry across the river at the mouth of Comb Wash, and put a big flat-bottom boat there. The Indians rode that with their loads on their ponies, set there, fifteen or twenty of them at a time, and came over. A couple of years afterwards the rains came and kept cutting the bottoms more; the floods drifted in, that country is a sandstone country. The La Plata is the top formation of that country between the base of the Chuckawala Mountain and the mouth of Chinle Wash; there the lime is raised again in the sandstone formation; on both sides of the river you have that fine drift sand on it. The heavy rainstorms in the country there washes gutters through it, little washes ten or twelve feet deep; then they have a dry season and the wind whips that and blows the sand along the ground like frozen snow; it fills these little gulches and washes all full

of that fine sand. A rain comes and washes that into the river, carries it right down, works the river plumb full of it. That helped to cut the bottom out more than anything; helped to cut the big cottonwood bottoms out. (R. 597.)

He means the channel has a tendency to fill with this sand; it fills the channel of the river bed a foot or two with this loose, soft sand. It has a tendency to throw the heavy body of the current of water against the banks at the sides; it undermines them and caves them in, cuts in a half circle, moon shape, until it will cut the bottom entirely in two, and probably the next day will go back to its old channel again; and after the waves worked on their south bank, it tipped their cribbing in that their ferry was anchored to, and they had no more ferryboat; all went into the river. (R. 598.)

He has seen this condition of the river at various places all the way from the Colorado line to where it enters the canyon at the mouth of Chinle Wash. There are no perennial streams that run into the San Juan River in the State of Utah. The first stream that runs into the San Juan that runs the year round is the Animus River. It comes from the San Juan Mountains in Colorado.

He has freighted all through that country and is familiar with all of the country north of the San Juan and with the country at the mouths of streams on the north side of the river. (R. 598–599.)

Supplies were first obtained in the wintertime from Santa Fe and in the summer time from Alamosa, Colorado. It would take from six to eight weeks to freight to Montezuma from Santa Fe by wagon. Later on they got supplies from Animus City above Durango. In those days it took about two weeks to drive from Montezuma to Durango and Animus City.

Freighting was done with horses and mules; with an empty wagon you would freight the seventeen miles between Montezuma and Bluff in one day; with a load it would take two days. Years later they got freight from Thompson Springs, Utah. (R. 599–602.)

He forded the river at Moab, Utah, in the early years when the water was low as it was easy to cross, the depth being about to the horse's belly. During high water he had to do some swimming, and daily mail crossed there.

Moab was settled two or three years after the San Juan country was settled. Greenriver was established when he first went there when he was a boy eighteen or twenty years old. (R. 602–603.)

The San Juan River was never used for the purpose of shipping in supplies with boats. He knows of an instance or two where people came down there with a little bacon and a bed; just as light as they possibly could. He paid a cent and a half and two cents a pound freight to have goods hauled from

Durango, and later from Thompson Springs. He looked into the possibility of boating stuff on the river at times but always decided it was impossible. They investigated bringing supplies down on the river. They never did it. (R. 605.)

Never saw any boats on the river except ferry boats, skiffs, little flat-bottomed boats, twelve feet long. They lost lots of them in high water. They very often made three or four during the season to ferry Indians across. (R. 605–606.)

When the placer miners were in there, some of them had no way of getting down to look at the bars; some of them built little bits of boats of this kind and went down.

He has taken a boat down the river from Montezuma to Bluff, and from Bluff to Rincon, mouth of Chinle, twice. He was a kid the first time, took it from Montezuma with another man, Montezuma to Bluff later years, when we would be down at the mouth of Comb wash—Rincon, they called their place; he made two different trips down; they lost their boats—rode a pony up.

Nobody ever brought any boats up that river. He never did. (R. 606.)

He was familiar with placer mining operations on the San Juan River and sold merchandise to the miners. The only way he knew of taking supplies in to them was by burros and pack horses. (R. 608.) He sold considerable merchandise to the

placer miners. He saw them come to the store with their horses and ponies, pack their merchandise on them and leave the store at the mouth of Comb Wash.

He is acquainted with the Honaker Trail. It is about seven miles below the bridge at Goodrich. Before the trail was built, Honaker, who was a placer miner there, lowered his supplies over the cliff with a rope and descended and ascended the rope. Later the trail was built from the canyon to the top of the rim, a difference in elevation of about eleven hundred feet. So far as he knows they took all of their supplies over the trail.

Mendenhall built a trail about one-half way between the Honaker Trail and the bridge. (R. 608–609.) This trail was established for the purpose all trails are, to ride ponies over and pack grub. (R. 610.)

He has done some placer mining. The most successful equipment used by the placer miners was the little hand rocker lined with burlap sacks or wool blankets. Very little heavy machinery was used. He was in the country when the first drilling for oil was commenced by Mr. Goodrich at the mouth of Comb Wash. The road from Bluff to Comb Wash was constructed by donated labor, so that they could get the drilling machinery down there. The drilling machinery was taken into Bluff with horses and wagons and eased down into the canyon with ropes or carried down. The wagon

road was never made to the creek; none of it was taken in by way of the river that he knows of. Mr. Goodrich sent in another drill to the bridge, crossing at Goodrich or Mexican Hat Basin. The machinery was hauled in there by wagon. Steam power was used, wood being burned for fuel. All the freighting to and from the oil well was done first with wagon and later with trucks. (R. 611–613.)

The preliminary part of the freighting was done with the horses which pulled all the first in; they put six horses on a wagon. (R. 614.)

In the early spring the water in the San Juan River is low. During May and June it rises due to the melting of ice and snow and has a fairly steady flow. During July it subsides. He has seen the river bed dry twice. He built a dam across the channel at Bluff and turned it into the irrigation ditch. The ditch was the width of a long-handled shovel. (R. 614–615.)

He has been down in the river bed when it was dry; he has been down in the river bed twice when it was dry; twice they made a solid dam across it and turned it all in their irrigating ditch at Bluff. In working the ditch they instructed the men to clean it the full width of a long-handled shovel; that is the width this ditch was; guess that is five feet. After the water was turned in the ditch would be probably eight inches deep, something like that; it run pretty slow; the survey runs on a sixteenth of an

inch to the rod; he is not engineer enough to tell the amount of water. (R. 615.)

He has been down the bed of the river when it was dry from Bluff to John's Canyon and Clay Hill, afoot and on horseback.

Another time they went to work a road up above Bluff. They camped the first night seven miles above Bluff; had to dig for water for their horses in the bed of the San Juan River; and all the Navajos were digging for water for their livestock. There was water in pools around rocks and the stumps of cottonwoods where it had washed; they were full of fish, and the fish had died, and their stock wouldn't drink water. But nothing running.

On that entire trip they were gone a week, maybe ten days, he does not know, they had to dig for water that trip. When they got back home, then the water came down. (R. 616.)

Along in August water in the river gets down to eighteen inches or two feet deep; you have to hunt a place where it is confined, to get water enough to bathe in. It spreads into three or four different streams and is full of wrigglers. This condition is in the river from Bluff to the Colorado line and from Bluff to the Colorado River. (R. 616–617.) That is the condition in the section from Bluff to the Colorado River or from the Colorado line to the Colorado River. To give you an idea, the bridge at Goodrich—the river is sixty-four feet wide there, confined in solid rock walls; the last time he bathed

in the San Juan River, it was the last week in August, and under that bridge there, where it is sixty-four feet wide, they couldn't get water deep enough to swim in. (R. 617.)

Sudden floods and cloudbursts occur in September and other fall months and water rises from one inch to forty and fifty feet. These floods occur usually every year at that season. During these floods all of the loose sands from the washes are dumped into the San Juan River, and chokes the river entirely across. (R. 618–620.) This occurs at Cottonwood, at Recapture, across between Montezuma and Bluff on the south side of the river; in all of them, in fact. (R. 620.) He does not know what effect this discharge of sand has on the river bed; cobble rocks and stuff comes down in these discharges, and it will take the river some five or six days to clean it up and wash it out; gets around the end of this delta, keeps caving it in; a lot of times there will be mud balls that roll down and cobble rocks. By mud balls he means this: Up in the clay washes there will be a clay bank cave off, a small one, the water in the flood will start to rolling that piece of clay, and it will pick up other pieces of clay, and get as big as the front wheel of a wagon. This will be composed of all kinds of sediment, cobble rocks, clay, sand, all rolled into a big mud ball; that is all washed into the river and they stay longer than the loose sand does. But in time the river cleans that all off, takes the rock and clay balls, too, and gets back to its natural channel.

There is nothing else but sand bars in that section. They are not stable. They do not stay in the same place day after day; they often change in an hour. (R. 620–621.)

There are rapids along down the river; he has crossed them on horseback at the mouth of Gypsum Creek at Mexican Hat. He has never been through them in a boat, but has just seen the rapids from the rim. (R. 622–623.)

After the town of Blanding and Monticello were established they obtained their supplies by freighting in overland by team and wagon.

The country is very sparsely populated. When he left there he estimated Blanding at 900 and Monticello at 300. He would say there are about ten ranches east of Monticello and a little settlement at LaSalle north of there where there are twleve of fifteen families. He would say that there are twenty families living east of a line drawn north and south through Bluff. During the time that he lived there there were no families living west of Mexican Hat and the character of the country is not capable of supporting a population.

He has had lots of experience with sand storms. In a sand storm the fine sand will drift along the ground the same as a snow storm and the grass might be buried in it and the next night it might reverse and uncover the grass. A large quantity of this sand is deposited in the river. (R. 623–626.)

He has had a great deal of trouble with quicksand on the San Juan. You can take the bars after

the water has receded and left the bars two feet above the present level of the water; very often their stock would get bogged down in quicksand on these upper bars in approaching the river to get a drink, and they would sink down sometimes until just their backs would stick out. (R. 626.) He has been engaged in an enterprise to attempt to confine the San Juan River to a definite channel; that was their big trouble. Did most of that at Bluff and at Rincon, at the trading post, at the mouth of Chinle Wash; they had trouble in all the places. One instance there, there was a sand ledge, sand shale, lime shale protruding over the river about twelve or fourteen feet high; the river came and hit it solid; they went to work and built a pier on the top of the ledge, cottonwood log pier, notched up hog-pen style, about twelve feet high, and filled that with rock; then over that they put a big, heavy cottonwood, extended it over the river channel beyond the edge of this cliff; built a water wheel so the wheel would hang in the river current at the face of this cliff. They got it to going; started to raise a little garden with it; and went out one morning and the river was over one hundred yards the other side of it, a sand bar filled in up to eighteen inches deep on their lower paddles; quit them entirely. That is common in that shifting sand.

The river at that point got back where he had built this crib. They went to work then; they

boxed in the inside of the wheel, tried to make a dry wheel out of it and run it by burro and sank a well there to lift the water or draw the water; it didn't work very good; they had a lot of trouble; in a week or ten days went out one morning there and the water was gone; came from the other side over to this side; that is a common occurrence in there. (R. 627–628.)

The rock crib he built is still there. He would say that Bluff fields that are farmed there are probably fifty rods wide by a mile and one-half long when he left, and when they first settled in Bluff he would say it was a mile wide by two and a half miles long, and when he left the difference had already gone down the river.

When he left the country three years ago he doesn't know of any land that was irrigated nor cultivated between Bluff and the Colorado River.

In the country west of Bluff somewheres there were lots of cattle and lots of feed, and they would go through alright, and the next year there wouldn't be half as many cattle and half of them would die. (R. 628–629.)

Most of this country he has been speaking of, for ten miles each side of the river, from Shiprock down to the mouth of Chinle wash, can be irrigated. If irrigated it is susceptible of cultivation. The finest piece of farming soil you ever saw in any country without an exception. If irrigated and cultivated it would support a very large population.

It would take lots of money to irrigate it, but it could be done; it is feasible.

There is not any such land beyond Bluff. Between Bluff and the Colorado there is nothing. He thinks he is safe in saying there is not a thing that could be irrigated, nor farmed if it were irrigated.

Piute Farms is in a canyon out toward Navajo Mountain on the reservation ground; it is not the reservation itself, west of the one hundred and tenth meridian, in what the President of the United States has jurisdiction to open and close. It is on the south side of the San Juan River. (R. 629–630.)

There is a great deal of land on the Navajo Reservation that is suitable to irrigation. This land that is suitable of irrigation is on the south side of the river from Chinle Creek up in places to Shiprock, New Mexico.

Cross-examination (R. Vol. 4, pp. 631–655):

The territory is twenty miles wide by forty long. That would make good level farm lands with some bad lands. It is a table-land country and on the north side you get the same. (R. 631–632.)

When he left Juab County to go into the San Juan he was probably ten years old, probably old enough to sit on a pony. He first settled at Montezuma and then at what he calls Rincon at the mouth of Chinle Wash. Chinle Wash and Comb Wash

come into the river at the same place on the opposite sides.

His father and brothers and himself ran the store and for probably five or six or seven years altogether. His father ran it for two or three and he was washed out and he moved on top of the hill. He lived in Monticello for about two years but outside of that, all of his time in San Juan County was spent in Bluff and the trading post there at Montezuma. He moved to Salt Lake about three years ago.

The placer mining began before he went to Montezuma. (R. 632–635.)

There is a very good road down the north side of the San Juan River from Bluff to Goodrich. This road was constructed originally by the pioneers when they first came into the San Juan country. The first of it was built when the pioneers went to Bluff they built most of it. (R. 635–636.)

There is no road along the river west of Goodrich to the Colorado River. The old emigrant road traveling westerly around the heads of the washes to the Colorado River opposite the Hole-in-the-Rock, Kumen Jones and party constructed. (R. 636–637.)

The first placer mining he had a personal knowledge of was about one-half way between Bluff and Montezuma. He ran into the first prospector there when he was out after milch cows. There were no placer operations that he would term operations; it

was all prospecting. They were hunting for gold. The placer operations were all on the gravel bars on the San Juan River. There was mining both above and below Bluff. The men would come in from the Colorado Mountains in the winter with their burros and while they were wintering there they would prospect the bars. This was nearly every winter he knew of after he got to Rincon, three or four years after they landed at Montezuma.

The oil drilling began in about 1909 and he had several permits himself and he is still interested in them. Some of his permits were right on the bed of the San Juan River and were United States permits. He doesn't hold any State leases. His original locations were made under the old Placer Petroleum Act. He has never engaged in any actual litigation with holders of State leases. (R. 637–641.)

He has seen this river dry twice, but in different sections. Once dry above Bluff, and once in the canyon right below Bluff. (R. 641.)

These are the only times he saw the river absolutely dry but he didn't set the times when he saw it dry so he couldn't remember. (R. 641–642.)

He has attempted to control the direction of the river lots; tried to protect their bottoms, so their fields would not be injured from the floods, and repair the damage that was occasioned by the floods that destroyed the original channel as he found it when he arrived there. (R. 644.)

The original channel of the river was destroyed by floods at various times; all of the damage was not done by one flood. The first flood occurred two or three years after his arrival at Montezuma. The river cut straight through their bottom, left part of their farm out on the other side of the river. (R. 645.)

The ferryboat constructed and operated by his father was in operation about eighteen months. It was constructed in the Spring of the first year and washed away in the next Spring or the following Fall. (R. 645–647.) They did not need a boat there all the time.

Most of the oil rigs came from Durango; that was the end of the railroad haul. Some came from Dolores. This was where the rigs were loaded on the wagons. They were mostly steel rigs from the Star Drilling Company, at Cincinnati, Ohio. They were not loaded in the cars in the vicinity of the San Juan River.

He is acquainted with Mr. Raplee who testified and he thinks a good deal of him.

In his opinion the timber that has been cut on portions of the watershed and trails leading down to the river, have contributed to flood conditions. The areas where the forests have been cut is on the head drainage of the San Juan River and is fifty miles long but he doesn't know how many wide. He saw a great many of the forests before they were cut, and he has seen the places where they have been. (R. 648–650.)

When he first went into the country the first sawmills had come in and were working there and the handiest, nicest timber on the flats was the first that fell. He would say that the cutting had began before 1896. The heaviest cuts were prior to the past thirty years. He knows there have been big mills operating there constantly for the last thirty years. He believes that the cutting of the timber on the watershed causes the quicker result in the running off. (R. 650–652.)

In order to get any freight down to the San Juan River from those points would have to do this. The railroad crosses the San Juan above at Farmington—comes to the San Juan; if you wanted to float it down, take it to Farmington on the railroad. (R. 655.)

The points where the rigs were unloaded were the closest points and distance from Bluff and were closer than Farmington.

He knows that there are thousands of acres of the finest land he ever laid eyes on lying north of the San Juan River in San Juan County, Utah, which is under the Dolores River if there was water in the river to irrigate it and there is also some excellent bottom land in Montezuma Creek canyon and side draws that would support a large population of people that is also under the Dolores water. (R. 653–655.)

By "under" he means capable of gravity flow from the Dolores River to this ground; all the

ground that you want, if the Dolores River were ten times the size it is. (R. 655.)

Redirect examination (R. Vol. 4, pp. 656.):

The ferry operated by his father was used during the high water season only, possibly three months during the year, and was operated for only a season and a half. During the low water periods the Indians and other persons crossing the river would ford it with ponies.

There were some miners, trappers and stock men in there when the settlers arrived but the settlers that formed the colonization were called by the Mormon Church. (R. 656.)

Recross-examination (R. Vol. 4, pp. 657–661):

He is acquainted with the placer mining operations of Mr. Raplee and others on the San Juan River. He became acquainted with Mr. Raplee shortly after he (Raplee) arrived in the vicinity of Bluff. The placer mines were only worked during the winter seasons and then only prospected. Mr. Raplee was not a settler. He was a Colorado miner and he first saw him (Raplee) when he brought in a little hand machine to test out the placer. He doesn't know how long afterwards that he went to where Mr. Raplee was placer mining but he went down many times. (R. 657–661.)

Redirect-examination (R. Vol. 4, pp. 661–662):

He sold Mr. Raplee goods from his store in Bluff and he never saw more than three placer miners

in one place. He has probably seen as many as fifteen or twenty working at times during the winter season. (R. 661–662.)

Recross-examination (R. Vol. 4, pp. 663):

There has never been any occasion when he has gone down the river and checked up on the number of prospectors working on the various banks and all he meant to say was that there had been times when he probably has seen as many as fifteen men working on the portions of the river where he happened to be and what men were at other points he did not know. (R. 663.)

JOHN J. LUMSDEN

For Complainant.

(Record vol. 4, pp. 664–686).

He resides at Grand Junction, Colorado, age 66 years, contractor and builder. He constructed a boat for navigation on the Green River in the Spring of 1905; the boat was built at Grand Junction, Colorado, and shipped to Greenriver, Utah, and finished there. It was fifty feet long, sixteen to eighteen foot beam, and drew from twelve to fourteen inches of water, according to his best recollection. The boat was propelled by means of a marine gasoline power engine and cost a little over $15,000. It was named the City of Moab and launched on the Green River at Greenriver, Utah, about the first of May, 1905. The City of Moab was constructed for the purpose of transporting

freight and passengers between Greenriver, Utah, on the Green River, and Moab, Utah, on the Grand River. (R. 664–666.) After launching, the boat they started on a light trip from Greenriver to Moab, carrying possibly ten persons, all of whom were members of the crew. The boat never did carry any freight between the points mentioned, or any other place.

Did not carry any passengers or freight at that time nor at any other time. (R. 666.)

They started at Greenriver, Utah, with perhaps as many as ten men aboard. They had a certain amount of supplies with them, anticipating they would probably be hung up in the river more or less; and they got down possibly pretty close to the San Rafael, where it empties into the Green, and ran onto a sand bar there that gave a good deal of trouble—that is, they ran into it pretty hard; it was a hard job to get back up again so they could get off the bar. They worked a good while, possibly seven or eight hours, got afloat again, got down a few miles further and the day was gone, so rounded in to the shore and tied up. (R. 666–667.)

The boat was released by means of prying with bars and poles and use of shovels and block and tackle. After getting off the bar the boat was taken four or five miles below the mouth of the San Rafael and tied up for the night. The trip was commenced from Greenriver, Utah, at about nine o'clock a. m.

Aside from the trouble experienced on the sand bar, considerable trouble was had in getting through what is called Corkscrew, where they had no control of the boat. Between the mouth of the San Rafael and the mouth of the Green River considerable trouble was encountered in the form of sand bars, gravel bars, rock, and shallow water; the trip in all taking about five days.

To the best of his recollection, they were about five days getting down to the mouth of the Green River; may have been more than that, but that is as near as he can recall it. Encountered a great many obstacles; there was rock in the river that fortunately showed up so could see them, and didn't jamb into these rocks in the Green River. Had to pick course from time to time, and sometimes was in brush, and sometimes was rubbing the rock on the side. It was anything but a pleasant trip for what they called the maiden trip. (R. 668–669.)

Got on other sand bars between the San Rafael and the mouth of the Green River. Got off a good deal in way described; some of them weren't so bad as the first one encountered; must have spent three-quarters of a day getting off that first sand bar. (R. 669.)

Does not recall going down; that many hours were spent in getting off bars; believes that they were hung up several times maybe for two or three hours, maybe an hour, as the case might be; but was working as fast as could; wanted to make

this trip, of course, successfully, and wanted to do it in as short time as they could.

When got to the mouth of the Green River proceeded to go up what they called the Grand River at that time (it is now the Colorado River), up to Moab, and felt pretty good about it until had gone some three or four miles, when encountered a big slide in the Grand River that the boat wasn't capable of making at all, but was foolish enough to go into this slide where the water was pouring over, and the first thing they knew, the boat was headed down the river, just turned right around; got into a big whirlpool where there were a great many trees and different size timbers in this whirlpool, got into that, it turned them around; turned them around at least once, not sure but more; finally got out of this whirlpool and went into the bank, into the rocks with the bow of the boat; that was on the bank of the river. (R. 668–670.)

They were fortunate enough to get off the boat and tie it up there, and so stayed there; not sure that they stayed all day, but stayed there quite a while, and tried to figure out some plan whereby might get up to Moab, but the more he thought about it the more he said they couldn't make any headway trying to get over that slide in the Grand River. It was impossible, so far as they were concerned, with their equipment; might have had winches put on the banks and snubbed the boat and wound it up this place, but didn't have those things,

and it wasn't what they intended to do; wasn't what they figured on was a practical scheme at all. So gave it up, and returned up to the Green River and started back to Greenriver, Utah.

On way back had a good deal of trouble getting up the Green River; had all the swift water to fight; the river was very high at that time; it was probably the first run-off in the spring, and the river was very high; would run up to where there was a sand bar showing up in the river, and the channel would be on either side of the sand bar.

Found some of the channels on same side when they came down; some of them were moved; but it was a question then which channel to take to get back up there; sometimes took the wrong channel; would then back up, and get into the other one, on the other side of the island; had a lot of that kind of work getting up as far as they came with the boat. (R. 671–672.)

Soundings were made in order to determine the river channel, especially on the downstream trip, a skiff being sent ahead of the boat in order to make soundings. Going back upstream this method was not feasible inasmuch as the current was too swift to row against; however, some soundings were made. The trip in all consumed about two weeks' time and a searching party was sent out to find if the boat was in trouble. The boat was tied up at a ranch possibly ten or twelve miles down the river from Greenriver and part of them went to the railroad

by team and went to Grand Junction, Colorado, the remainder staying with the boat. (R. 671–673.)

Grand Junction, Colorado, being on the Grand River, it was first thought that if the boat were built there it could be shipped down the Grand River to Moab, but after carefully going over the conditions, seeing the river through Westwater Canyon and other places, it was decided that the risk would be too hazardous and the boat, or hull, was therefore shipped over the Denver & Rio Grande Railroad to Greenriver, Utah. Charles Anderson was pilot on the maiden trip. Before the maiden trip was made a preliminary survey of the Green and Grand rivers between Moab and Greenriver was made for the purpose of determining the depth of the stream and channels. Captain Charles Anderson, pilot of the boat, was a member of this preliminary survey party. The party boated the rivers in a small row-boat and took soundings. This survey was made while the City of Moab was under construction in Grand Junction.

The City of Moab was then taken from Greenriver to Saltair on the Great Salt Lake, where it was used as an excursion boat. (R. 674–676.)

After he found he had made a mistake trying to ply the Green and the Grand River, the conceived

the idea they would take it out to the big Salt Lake in Utah, and Mr. Anderson went over and made a contract with the management at Saltair to put the boat on there, and was allowed to carry passengers for excursion trips around over the lake. (R. 676.)

Before the boat was taken from Greenriver to the Great Salt Lake it was overhauled and changed because of damage done on the trip up the river.

There was damage done to the propellers coming up the river; broke some cables, the steering cables. (R. 677.)

Cross-examination (R. Vol. 4, pp. 677–683):

There was Mr. Yokey, Mr. Anderson, and a man named Perry in the crew. (R. 679.)

It was six or seven o'clock that the boat tied up four or five miles below the mouth of the San Rafael on the first day of its maiden trip. The first day's trip, therefore, consumed from nine to ten hours. The boat was propelled by twin-screw propellers. The draft of the boat was from twelve to fourteen inches. (R. 677–681.)

He observed shifting of the channels. (R. 681.)

It was the same channel they attempted to go back up as they had come down in that they had trouble in; water flow had changed it entirely.

To make it clear, for instance, going down would have a channel probably fifty feet wide going down, and when came back up, this fifty-foot channel he speaks of wouldn't admit of the boat coming back up, because the sand bars and the gravel had shifted, hence, had to take the other side, where they found more water. The volume of water should be more; had more when came back up than when went down; the river was rising instead of receding. (R. 682–683.) Can not tell where this place was. There were good many different places on the river; several. (R. 683.)

Further examination (R. Vol. 4, pp. 684–686):

The power wouldn't stem this cataract. A few places couldn't make it at all.

If he had had power, from his observation, he does not believe he could have got through there. (R. 684.)

He was not positive whether the preliminary survey on the river before the launching of the City of Moab went as far as the Slide on the Colorado River or not.

The boat was constructed for the purpose of transferring passengers and freight on the rivers and it was anticipated that freight could be carried cheaper between Greenriver and Moab by way of the rivers than overland by road. (R. 684–685.)

If the navigation had proved successful he expected to carry freight cheaper than he could carry

it across from Thompson overland. From Thompson's they used to carry all the freight. Any freight coming in from the west to Greenriver, they were proposing to carry cheaper by this water route than across over to Moab. Had there been freight, would have taken it. (R. 685.)

Recross-examination (R. Vol. 4, pp. 686):

He believes there would be more or less of a great attraction for tourists to see the scenery of the river but that wasn't in his mind at the time he went down the river. When they went down the river they did not have any government or army survey maps. He couldn't identify the bar he had trouble with on the San Rafael outlet (R. 686.)

Recalled (R. Vol. 4, pp. 759–762):

He was one of the proprietors of the "City of Moab" which was afterward called the "Cliff Dweller."

He got a report from Mr. Anderson as to what took place on the second trip.

After he got that report, he took the boat off the Green River and shipped it to Salt Lake City, because in the first place, they found their first plan of operating between Greenriver City and Moab was a total failure; they saw they couldn't make any money. (R. 760.)

He came to the conclusion that navigation between Greenriver and Moab as far as their boat was concerned was a failure.

Recross-examination (R. Vol. 4, pp. 761–762):

Some investigation was made by him as to the probable tonnage of freight that might be carried on the boat between Moab and Greenriver and it was expected that some passenger traffic would be handled. With this business they expected to make a fair return on the investment.

It was an attractive proposition for using it on Great Salt Lake, and he decided that was a more profitable field; thought so after giving up the other one down there. (R. 762.)

ARTHUR H. SPENCER

For Complainant

(Record vol. 4, pp. 687–719)

He resides at Denver, Colorado. He is an oil man and Indian Trader, and went to San Juan County, landing on the San Juan River in 1878; when he was a boy. His father started an Indian trading post and then moved to San Louis Valley, Fort Garland, Colorado. The family settled first at Farmington then Four Corners, and later at Mancos. The store on the San Juan was kept until 1884.

His education was as a mechanical engineer, but he is also an oil driller.

He has been down the San Juan River many times. In 1908 he moved into Mexican Hat and

engaged in drilling for oil and trading with the Indians. He located some oil claims which he still holds. His supplies and equipment were hauled down the river by pack outfit and bull team. (R. 687–688.)

He did not take any of his supplies down the river by boat and has been on the San Juan River in a boat only to cross it. (R. 688.)

During his stay on the San Juan River he took twenty-eight pictures included in Compl. Exhibit No. 100, which represent the stream below Bluff, Utah. These pictures were taken during different months of different years and represent different stages of water and the nature of the canyons, the latest pictures were taken in 1918. (R. 689–693.)

Photograph marked No. 1 is the Big Goose Neck twenty-eight miles west of Bluff and two miles north of the Honaker Trail.

Photograph No. 2 is the old steel bridge at Goodrich, which was washed away in 1911; the big flood. (R. 690.) The road shown goes on out to Moonlight, Kyenta, Arizona, Flagstaff, Tuba City.

Photograph No. 3 is the Goose-Neck just below the Mendenhall Goose-Neck.

Number 4 is looking up the river from number 2 Goose-Neck and shows Mendenhall's cabin.

Number 5 is a cross section of the same Goose-Neck.

Number 6 was taken at the mouth of Comb Wash in the spring, about June, when the spring rise was on. (R. 691.) This picture was taken in 1912 and the pictures were just taken out of curiosity.

Number 7 is the Navajo Crossing across from the mouth of Moonlight Creek.

Number 8 is flood water coming in just at the mouth of Gypsum Creek right at Goodrich. (R. 692.)

Number 9 is a flood going down at Goodrich and is taken right where the bridge was. There is a new suspension bridge there.

Number 10 shows the canyon just below Goodrich and shows how low the river gets and he would judge the river is about sixty feet wide. (R. 693.)

Number 11 is right out from what he calls the second Goose-Neck on top of the mesa.

Number 12 is Monumental Valley; that is typical of that country. It is called Moonlight and lies a little south and east of Goodrich.

Number 13 is one of the high waters just above the mouth of Gypsum. The picture was likely taken in June. (R. 694.)

Number 14 is the new suspension cable bridge. The picture was taken the last of June or the first of July.

Number 15 is right down from Goodrich showing the formation Goodrich and Mexican Hat. It is all one little basin.

Number 16 is the oil field north of the river from Goodrich showing the Blue Mountains and is typical of that country.

Number 17 shows the formation below Mendenhall Goose Neck and was taken in fairly high water in the spring.

Number 18 shows the Honaker Trail. He has been down over the trail and it was used to pack supplies to the placer miners.

Number 19 is the Goodrich flat at Goodrich.

Number 20 is a mud flat right below Goodrich. There is quick sand between Goodrich and the mouth of Gypsum. (R. 695–696.) They placer mined there once and they placer mined all up and down the river at different times.

Number 21 shows ice blocks. The picture was taken right where the bridge is at Goodrich.

Number 22 shows his brother trying to cross the river right below Goodrich. (R. 697.)

Number 23 represents the San Juan River right at the Goodrich bridge and was taken about July of 1920. The river at that time in that particular place was about ten feet wide. People were right on edge of water in river. Can step across it there. (R. 697–698.) Right there it is only ten feet. When it gets up high, spring water there, it would be about fifty feet, forty feet; something like that. Depth is knee-deep there right now. (R. 698.)

Number 24 he believes is called the third Goose Neck below Mexican Hat.

Number 25 is a picture north of the oil field just right north of Mexican Hat. It is about eight miles north and is typical of the country. The road shown in the picture stops there; he built it. It is a road from Mexican Hat and was built to put in oil machinery.

Number 26 is what is called the canyon above Soldier Basin right east of Mexican Hat about six miles.

Number 27 is part of Soldier Basin near the previous photograph [Number 26]. (R. 699.)

Number 28 is in Lime Creek north of the river. (R. 700.)

He has observed the high water run-off in the spring of the year and the floods which come in about September. In the Spring the water rises gradually in the stream and subsides gradually but during floods in the fall of the year the stream rises rapidly, takes everything before it, and immediately subsides. The flood waters do not occur with any regularity in the fall of the year. He has never known of any boats being used for navigation up and down the river. They were just used for crossing purposes. (R. 700–701.)

From 1892 to 1901 he was a freighter and carried supplies down the San Juan River to placer miners and others in 1893 and 1894. During the time he was on the river he did not know of any prospectors bringing supplies down by boat.

Has never seen the San Juan River dry but has seen it above Bluff when it was very low and contained only small pools of water with little streams running from pool to pool. This condition existed in 1883 and 1917. The stream at Goodrich, Utah, contained about as much water as two good sized irrigation ditches and the river was very low but the water ran through in a solid stream. At that time the stream at Goodrich was not twenty feet across. (R. 700–703.)

At Goodrich in that year, those two irrigating streams were not twenty feet across them. They had a lamb there only six months old that used to ford it, run across back and forth. You can guess what it was. (R. 703.)

He has seen other years when the water in the river was practically as low as that mentioned. This low water occurs in September and October.

Quicksand lends difficulty to crossing it back and forth all the way from Largo Canyon to the mouth of the San Juan. (R. 703–704.)

He has had occasion to pull cattle out of the quicksand in the river. Sand bars form in the river at different places along its course. They will form in one place, then wash out and form again somewhere else.

He has been all the way over the San Juan River between Mexican Hat and the junction of the Colorado afoot, crossed it. All the way down, went clean through the canyon to the mouth of Nokai;

surveyed that whole country out there for oil permits. That is about forty miles east of the mouth of the San Juan. (R. 704–705.)

Cross-examination (R. Vol. 4, pp. 705–719):

In 1893 he freighted drilling machine and placer machines into Bluff and lumber down on below Bluff. The material was obtained at Mancos, Colorado, the drilling machine being left at Bluff and lumber taken on down to Zahn's Camp at the mouth of Nokai Canyon, about seventy-five miles west of Bluff on the San Juan River. There was no road from the mouth of Comb Wash, where he crossed the river, to Zahn's Camp; he merely took the freight across country and constructed his own road where it became necessary. (R. 705–708.)

Road there was not good; rough country; went by way of Bluff; made own road when had to; didn't build a road clear through there; went across the country. When got to Moonlight going into Copper Canyon, had to build a couple of grades, something like that; didn't build a road all the way down there. Followed a road to Bluff City.

From Bluff City followed a road to Comb Wash; after they had crossed the river at mouth of Comb Wash. Were on south side of river.

Followed Indian trails most of the time. Not following a road. (R. 708–710.) Difference between Indian trail and a road is this: An Indian trail is where Indians have got to work at a place to go through horseback.

Naturally he would speak of a road that you can go over right with a wagon, that has been traveled over once in a while. That is a wagon road. If just a wagon track, wouldn't call it a road. (R. 710.)

About a year elapsed between the first and second trip and he has been freighting ever since. He hauled a machine into the mouth of McElmo east of Bluff about thirty-five miles on the San Juan River. He only made the two trips down to Bluff between 1893 and 1901. The balance of the time was up above Bluff on the San Juan. (R. 711–712.) While he was freighting he used to go to Bluff or below on horseback.

He would go there in search of cattle as the whole country was their winter range east of Bluff.

When he would go west of Bluff was when he would go out on the Navajo Mountains prospecting in the winter, or to trade with the Indians. (R. 712.)

He couldn't tell when the next occasion was he went to Bluff; that is, he couldn't specify the dates but he went in 1908 and lived there for twenty years. He did some prospecting both before and after 1908 in Copper Canyon and in the Navajo Mountains west of Bluff on the south side of the river in the Navajo Reservation. Copper Canyon runs into the river at the mouth of Nokai. It is a tributary of the San Juan. When he went to the

San Juan to live in 1908 he was at Bluff and moved to Mexican Hat in 1914 and traded with the Indians. (R. 713–714.)

The twenty-eight pictures that he brought into court weren't picked out by him. They were picked out by Mr. Payne and he believes he has hundreds that show the river at low water and if he can find them he will bring them to-morrow. R. 715–716.)

The pictures Mr. Payne selected were some he happened to have at his house in Denver but they were not all he has. He knew he was going to be a witness about two months ago.

He is interested in patented oil lands on the San Juan River but is not interested in any land that is not patented and has no leases from the Government. Some of this patents are adjacent to the river bed but not right along the river bed. He doesn't know whether the Government in the suit has excluded the lands in the river bed on the San Juan, adjacent to his patent. He knows they reserved something like a quarter of a mile on the north side years ago. (R. 716–719.)

CHARLES WARNER ANDERSON

For Complainant

(Record, vol. 4, pp. 720–738)

He resides at Gallup, New Mexico; carpenter; has operated boats on the Green River, the Colo-

rado, on the Great Salt Lake, and a little in the old country. Assisted in the construction of the *City of Moab* at Grand Junction, Colorado. The *City of Moab* was about fifty feet long, fourteen feet beam, and drew twelve or fourteen inches of water. The cabins and the finishing work on the *City of Moab* was done on the banks of the Green River at Greenriver, Utah. The power used was 25 horsepower Watkins engines, and the boat was propelled by two tunnel type propellors. (R. 720–722.)

Prior to launching the *City of Moab,* he went down the Green River in a rowboat for the purpose of surveying the river and determining the location of the channel and the depth. The trip was made in a sixteen-foot rowboat or skiff. He was accompanied on the trip by Mr. Yokey and Arthur Perry. The trip was made from Greenriver, Utah, to Moab, Utah, in March or April. (R. 722–723.)

Considerable trouble was encountered between Greenriver, Utah, and the mouth of the Green River as sand and gravel bars were numerous, it being necessary to push the boat over the bars. At the mouth of the Green River the party walked down the Colorado to see the first two or three cataracts and then proceeded up the Colorado River in the rowboat to Moab, encountering little or no difficulty in making the trip except that it was hard rowing.

At Moab they left the boat and took the stage back to Thompson, Utah.

The *City of Moab* was launched at Greenriver on the fifth or sixth of May, 1905. Two or three days after the launching, the trip down the river was started. Some trouble was had in launching the boat since it got stuck in the mud and it took two or three days to get it out. The first trouble encountered on the cruise occurred just below the railroad bridge on a riffle known as the Ferry Riffle, where the boat hit the rocks. Other riffles were encountered all the way down to the mouth of the Green River and the boat struck bottom many times. Considerable trouble was experienced in handling the boat, inasmuch as the water was very swift and they had to ride with the current and take chances. (R. 723–726.) He steered the boat.

In that stretch of the river the channel is not straight. It turns all around, every direction; one minute you are on this side; the next you are over on the other side; the current will turn right over on a bar, drop over on that side, and the next minute go over on a bar on that side; you can't tell where it is; you have got to change around all the time.

Made soundings of the water as went down; had a man sounding all the time; he would stand there hollering out, "Plenty water here," "Plenty water here"; the next minute they hit right up and knock them all overboard. (R. 726–727.)

Little trouble was experienced with sand bars between Greenriver and the mouth of the San Rafael, but below the mouth of the San Rafael and

down to the mouth of the Green River considerable trouble with sand bars was experienced. The trip consumed from four to five days in going from Greenriver down to the mouth of the Green River. (R. 727–728.)

Couldn't tell how many sand bars got stuck on in that section; there were quite a number of them; twenty-five, thirty, somewhere in there, anyway.

When got stuck on sand bars would have to get off and work around the boat; sometimes take a line, run it over where we could get it fast and make it tight on the capstan, and tighten it up, then work the current next to the boat and wash the sand away from it, get the current started and wash the sand away; then take shovels in the bed and start the water under it; then it would commence to wash.

Would start water under boat by working from above the boat and down, had to go under it some corner, some place, get the current started. When the boat hit the sand it made a dead water right there; start in on one side and work with the shovels until we get the water started. Didn't take long to cut it when it gets started once. That is the way worked it. Made a line tight, so the boat couldn't move, and managed to get started, and in that way it will work loose.

In order to do the work with a shovel in there, it was necessary that somebody get in the water; all got out and worked hard all around, everybody

worked that could; the whole crew. If didn't hold the boat up there until the water got washed under that boat, if you let it float, you get it tighter and tighter; if you hold the boat up there and get the water away from it, you get a channel through and get loose. (R. 728–730.)

After leaving the mouth of the Green River the party proceeded up the Colorado River as far as the Slide, where the boat was thrown back out of its course and onto the bank. After looking the situation over it was decided that it would be impossible to take the boat up the Slide and the trip back to Greenriver was started. (R. 730–731.)

The trouble there was not the width of their boat. The water came through so fast they couldn't go through it.

No trouble with the power. Had plenty of power for that size boat for ordinary river navigation. Had plenty of power.

There was no boat that could get up, because it would drown you, sink you right there. The only thing that saved them from getting drowned was, when he got up to it he saw what he was up against, and he swung the bow over and butted into the rocks; it threw him out; he didn't get the swell of the water over him. That is the fact of it. (R. 731–732.)

The trip back up the [Green] river wasn't quite as hard as the trip down, although the crew was fighting sand bars all the way. The sand bars were encountered all the way along the trip. (R. 732–733.)

After got to the mouth of the San Rafael, had trouble there; stayed there about two days; that is where the balance of the crew left.

Ran on a bar, on the San Rafael bar; Mr. Ross was at the wheel at the time. (R. 733.)

In this trip up did damage to boat. Broke the propeller blades off. (R. 733.)

At the San Rafael bar the blades were broken from one of the propellers. The boat, after getting off the bar, proceeded up the Green River to Halverson's Ranch, where it was tied up and left.

The boat was remodeled at Halverson's Ranch. A Scotch marine boiler was used to generate steam power and a stern paddle wheel put on the boat in place of propellers.

After the boat was remodeled another trip down the river was started and the same troubles encountered as on the first trip. (R. 733–736.)

Did stick between Halverson's and mouth of San Rafael; stuck there, too, that second time, because another boat coming down, he got stuck on the bar there, too, a fellow named Ottenheimer, who had a small power boat, about twenty or twenty-five feet long, he had built in Greenriver. (R. 736.) A fellow named Durant went with him. He got stuck there on that bar. They were tied up to the shore then. Dr. Durant, he jumped out of that boat and walked in shore, and asked if he could go up with them. He quit that boat right there; it set on the

bar; couldn't get it loose. He quit it right there, and came over and wanted to ride up with them. (R. 736–737.)

One thing that helped them out was the stern wheel: it helped churn the water out when they got stuck: the machinery would churn the water up until it got some of the sand out from under them and make a suction there and help them out. (R. 737.) He identifies complainants' Exhibit 101 as the boat *City of Moab.*

On the second trip the *City of Moab* went down as far as Valentine's Bottom, then turned around and proceeded back up stream. Considerable trouble with sand bars and gravel bars was experienced on the up-stream trip. (R. 738–739.) Just one sand bar after the other; there would be a straight wall of sand there, the water would be washing, it kept falling off and falling off; fall over that way, and next day start to go the other way; that is the way it kept shifting; you could see it fall all the time. (R. 740.)

The voyage was stopped at Ferry riffle, about one-quarter of a mile above the railroad bridge at Greenriver, it being impossible to get the boat over the riffle. (R. 740.)

In making the trip the boat burned all of the bunker coal and it was necessary to substitute driftwood to complete the trip. After leaving Greenriver the boat was dismantled and taken to

Saltair on the Great Salt Lake where it was remodeled and named the *Vista*.

About fifteen days were consumed in the first trip down the Green River in the *City of Moab*. (R. 741–742.)

Cross-examination (R. Vol. 4, pp. 742–754):

The survey trip he made in a row boat was the first time he had ever been on the Green or Colorado Rivers, and aside from the data secured and experience had on the boat trip he had no other assistance or information for operating the *City of Moab* on the river. They had a captain along who carried a captain's papers on the sea. Both the Colorado and the Green Rivers were very muddy. (R. 742–743.)

After going down the river in the small boat making soundings and locating impediments to navigation, it was decided that although they might have some trouble in navigating the larger river they didn't expect the type of trouble that was encountered. It was higher when he went through with a rowboat. (R. 743–744.)

He was of the opinion that he could have taken the *City of Moab* through the Slide at the time he went through with the rowboat but that it could not go through during high water. (R. 744–745.)

On the second trip with the *City of Moab* no purpose or objective in making the trip was in mind; the boat was merely taken down as far as Valentine's Bottom and because of increasing difficulties in navigation turned around and started back up stream.

After arriving at Greenriver the boat was tied up at the bank. (R. 745–746.)

The new boat was ten feet longer than the other boat but just the same width; if anything was a little heavier as they had a boiler aboard. One thing that stopped them on the second trip was the lack of fuel.

The water appeared just the same on both trips; there was a little bit more water on the trip he made in the canyon.

When they left Greenriver they intended to go to Moab. They took all the coal they could hold on the boat. If they had any coal when they got back he doesn't know anything about it because they ran out of coal before they got back and burned drift wood found along the river. (R. 746–748.) Had no dock; tied it along the bank. There was no other place to tie it, just the bank there; wouldn't call it suitable; it had to do. (R. 749.)

He was unable to find any well defined channel in the Green River inasmuch as the sand bars were shifting from place to place and the deep water changing at all times. (R. 750–751.)

There was a channel in the Green River, but there was no defined channel. (R. 750.)

There were changes in channel at particular points between those dates (R. 751); there were changes all the time, one place to another.

The channel, what you call the channel, changed from one place to another. (R. 752,) Can not tell in general at what places because so many of them

you couldn't keep track of them; he couldn't do it, nobody else could.

You can tell a change has taken place when you hit it, when you come along down there and try the same place and get stuck, and had been down there before, there must have been a change. He did remember some of it at that time, those places, when he was there.

It was difficult to tell a channel had changed. (R. 752–753.)

Redirect examination (R. Vol. 4, pp. 754–755):

When the boat was changed around into the *Cliff Dweller* all the cabins were taken off and the upper deck was left the same it was and the stern was put on behind and the pilot house was taken off. He can't fix definitely the month that the *Cliff Dweller* made the trip and the name was changed from the *City of Moab* to the *Cliff Dweller*. (R. 754–755.)

Recross-examination (R. Vol. 4, pp. 755):

The cabins were taken off and the boat was lengthened on the second trip. (R. 755.)

Further examination (R. Vol. 4, pp. 756–757):

He was not financially interested in this boat. He made a report to the owners about this second trip.

He reported to them that the river could not be navigated with that boat. Gave it up.

The boat had been built for the purpose of navigating this particular river, and it was launched on the basis of the reports made by him on his trip down with the skiff.

Not much difference in the draft on second than on first trip. She was loaded with coal instead of gasoline. Weighed about the same; had to carry gasoline and coal the biggest part of the time. So that there was nothing in the condition of the boat that made it more difficult to go down the river on the second trip than on the first. (R. 756–757.)

He believes the boat was shipped to Salt Lake City the following Spring and before it was shipped it just lay at Greenriver.

ELLSWORTH L. KOLB

For Complainant

(Record vol. 4, pp. 763–877)

He resides at Grand Canyon, Arizona, is 53 years old, and has had a common-school education and what a person would pick up in a business way.

In 1901 his brother and himself established a photograph studio in the Grand Canyon and it has grown from a small to a nice business in scenic photography. (R. 763.)

His brother and himself in 1911 started at Green River, Wyoming, on the Green River and went through all the canyons of the Green River and from the junction of the Green and the Colorado to Needles. He afterwards got a boat and continued on down to the Gulf.

In 1921 he was selected by the government to handle their boats on a survey through Cataract Canyon beginning at Greenriver, Utah, and down to Lees Ferry. The first trip started September eighteenth, 1911. They had two boats of the Galloway type, sixteen feet four inches in length, flat bottomed, decks at either end and a hatch covering the top. (R. 764.)

Nearly all provisions or photograph equipment were carried under the decks and there were two air chambers in either end of the boat, under the decks, with an open compartment in the center for a single oarsman. They had a four-foot beam and would draw, when empty, not over four and one-half inches. When loaded up to 1,200 pounds it would draw eight inches in the center. The bow was two inches higher than the stern with about ten-inch rocker from bow to stern. The rocker allows the boat to be turned very quickly. It is in that shape that by pushing on one oar and pulling on the other you can turn the boat very quickly at an angle in the current. If the boat is flat-bottomed, it is very difficult to turn in a swift current because it wants to keep its course. If it is a keel boat, it is even worse. (R. 764–765.)

They had lived there at the canyon nine years before they made the canyon trip and knew of two parties that had gone through. He heard reports of the trip of Russell R. Monette. This is the same trip Bert Loper started on but did not come

through. Two years previous, J. F. Stone of Columbus, Ohio, and Nathan Galloway, a hunter and trapper, went down with a party of five people. He had corresponded with Stone before he came through as to the possibility of going as a photographer. He had also read the books published by F. S. Dellenbaugh who accompanied Major Powell on his second trip and Mr. Dellenbaugh is recognized as the great historian of the Colorado River. (R. 765–766.)

He believes they left Green River, Wyoming, September 8, instead of September 18, and with his brother and James Fagin.

Prior to the time they went on this trip he had crossed the river several times about a mile above Bright Angel trail. His brother had had considerably more experience and had swam a great many horses across the river. (R. 766–767.)

There was a whirlpool and a lively riffle. His brother crossed many animals there, but he was only in on one of these experiences and had had no experience in running rapids before he started the trip. (R. 768.)

Starting at Green River, Wyoming, it was approximately sixty miles, he believes, down to the first canyon and there was too little water to make any speed and it took them about four days. They were down to the Utah-Wyoming line. (R. 769.) Just across the line, he entered Flaming Gorge.

They had hit some little riffles in there that they called rapids, because they hadn't seen any real rapids, or hadn't taken their boats into any real rapids. (R. 770.)

There is Flaming Gorge, Horseshoe and Kingfisher Canyons that are not more than twelve miles in length. Major Powell named them when he went through.

There was a little quiet water and park below the short canyons then they came to Red Canyon which, he believes, is about sixty miles in length and it had some bad rapids in it. (R. 770.)

Bad rapids in most cases up there are caused by side canyons which come in in the flood stages, washed rocks of all sizes up to ten feet in diameter into the river; they dam the river; there is a great deal of silt as well washed into it, and it causes quiet water above that point, and the water spreads out possibly a quarter of a mile, sometimes shorter, sometimes a third of a mile, and it causes violent water going over those rocks.

From the Utah line to the Colorado line there was one rapid at the lower end of Red Canyon called Vermillion Creek, a rapid that caused trouble, and one boat was run through and hit rocks, and another boat was lined through.

Then there was another rapid where one boat was taken through and the other boat was lined through.

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His brother had more experience than he. His brother's boat was run through where his was lined. (R. 770–771.)

He doesn't just remember the length of Red Canyon and it might be shorter than what he said it was.

They lined one boat at two different places in the canyon and it was one place called Ashley Falls, in the State of Utah, where there was a very narrow channel and they had extremely low water. This is the only point outside of the two rapids that he recalls. He only remembered the places where he had a little difficulty. The river in that country averaged about one hundred and fifty feet wide in low water and it was comparatively shallow. Gravel from the shores had gradually deepened to the center and he had great difficulty with their boats dragging on the rocks on account of extremely low water.

They came into quiet water in Brown's Park that is in Utah, and the river changes its direction and goes directly east and somewhere above Lodore Post Office enters Colorado. (R. 778–779.) The Canyon of Lodore is in Colorado and it makes a loop and comes back into Utah again, and after going into Whirlpool Canyon and Split Mountain Canyon; it is very close, he believes, to Utah or Colorado.

It rained in Lodore Canyon and they had a six-foot rise in the river and the Yampa River came

in and that added considerable water and the river conditions were different from that time on. They were riding on the crest of the flood. They got through without any mishap, but they considered themselves lucky. That is true of all rapid running. (R. 780.)

It was not necessary to line the boats at Split Mountain or at Whirlpool.

A valley commences directly below Split Mountain that reaches past Jensen and the descent of the river is much less than in the canyons up above; the river widens out and there are cattle ranches on either side. (R. 780.) They made the run down to Jensen in a day. Jensen, Utah, is near Vernal.

He calls it quiet water when running about two or three miles an hour. (R. 781.) To explain, most of the canyons seem to have the violent rapids; out in the valleys the water is comparatively quiet, different altogether from the water that they would find in these upper canyons. (R. 781.)

They stopped at Jensen and went out to Vernal and then from Jensen to Ouray. They made the run in a day and a half. It had rained a good deal and they had a favorable high water stage. (R. 781.)

After they left the valley they got in what is called Desolation Canyon. The walls are not high at first and the water is quiet through the greater section. Towards the lower end of Desolation Canyon they began to find rapid water and rocks again.

This happened above Rock Creek, that might be forty or fifty miles above Greenriver, Utah. Rock Creek is on the east side of Greenriver above McPherson's ranch. McPherson had a trail up there and would drive his cattle up there. (R. 782.)

Found numerous bad rapids through that section. By bad rapids, he means rapids that would have a fall of twelve or fifteen feet; most of that fall would come at the beginning of the rapid.

Twelve or fifteen feet in one hundred and fifty yards, then the violent water, big waves and whirlpools would continue some little distance below that, but there wasn't the danger of striking rocks with their boats, that they would have at the beginning of the rapids; that is the usual difference; and through nearly all that section they would find one such rapid per mile; that is a pretty good average. In Desolation Canyon now. The name changes to Gray Canyon just below McPherson's ranch; there are much the same conditions in the upper end of Gray Canyon; the rapids are not quite so bad; it is lively water; the descent is more continuous; that is, in Desolation Canyon would find a rapid, then directly at the foot of the rapid comparatively quiet water for two-thirds of a mile, perhaps, sometimes longer, sometimes less. Then you come to another rapid, and go over that in the same way.

Ran rapids in Gray Canyon; there was one specially bad rapid right at the beginning of Gray Canyon, on account of a little river that came in from the west. (R. 782–783.)

He believes Rock Canyon had trout in it, and the little river that came in from the west, he believes, is Price River and there were streams that came in that would give the impression that they were permanent streams and as they came down this stretch of the river, there would be more and more water in them and the current was increasing as they came down.

There is a road that nearly parallels the river from McPherson's ranch to Greenriver, Utah.

The water here was lively but wasn't especially dangerous and they made good time.

Gray Canyon ends, he believes, between fifteen and twenty miles above Greenriver. (R. 784.)

Immediately above Greenriver, the water is compartively quiet. They found sand bars and islands in the middle of the river and channel on both sides. One of them would be deep and possibly one would be shallow and they would change. (R. 785.)

Would ground frequently on sand bars; would back off as best could; had an extra oar, and would push the boat, try to get back in the channel. (R. 785.)

Between Green River, Wyoming, and Greenriver, Utah, are ranchers in different sections; in Brown's Park, ranchers had boats tied up to the shore. They were very hurriedly made, flat-bottom almost invariably; quite often the boards were nailed just across, and just took two boards and bent them for the sides and nailed these boards across.

Did not see anybody in a boat on the river.

Did not see any power boats. (R. 785–786.)

The dam site was for irrigation purposes; it had just been installed, they had just finished it.

Made the run from Greenriver, Utah, to Wolverton's ranch in one day. (R. 786.) He believes Wolverton's ranch is about twenty-four miles below Greenriver and the water in that section is swifter than at Greenriver and there are numerous rocks. (R. 786.) Some of them project above the surface of the water, and most of them directly underneath. You could drag the oars and touch the rocks.

It was about five weeks from the time they started until they left Greenriver, Utah. (R. 787.)

Ran on these riffles of bars between Greenriver, Utah, and the mouth of the San Rafael; in one or two instances the boat would get on a rock and the bow would stick and then swing clear; it would swing around; and when they would run rapids they reverse their boat and go into it stern first; they face downstream; they have a square look at the danger that is ahead; if it is a rocky rapid, you are looking directly at the rocks.

On the bad rapids, the very bad rapids; as soon as they heard the rapid they would reverse the boat, instead of pulling downstream, like they do in quiet water, trying to make time, they would turn directly around, they would enter the rapids stern first, and they would be pulling against the current and check the speed of the boat so if you hit a rock you don't hit it so hard.

The boat had considerable rocker, and would turn very quickly; in many cases these rocks project in the only available channel where you know before you get to the rock that the boat has to be turned at an angle, and they would pull over a little to one side and endeavor to pass that rock, and in order to check the speed they would drop in behind—a rock sticking above the water gives a little quiet place, even in the middle of a rapid—they would try to drop into that and get a new grip on the oars and continue on down, and sometimes would have to change the channel four and five times going through a rapid.

Proceeding from the mouth of the San Rafael soon get into Labyrinth canyon.

Had difficulty in that canyon with sandbars; frequents would run on to the sandbars; the river spreads out, has a widening course, changing channel; it would be approximately four hundred feet wide; most of the time it was wider than that, on account of spreading out; it had room to spread out; and sandbars, almost islands, would be just up to the surface of the water; sometimes could tell where they were; the wind sometimes makes a difference. Sometimes we couldn't tell it; some times would hit them pretty hard. But would endeavor all the time to look over their shoulders and pick out what they thought was the running water, the deeper channels, but that changes a great deal from side to side, and especially if the course of the river is changed, if it is not a straight river.

They had two boats and three men. One man lasted one hundred and sixty miles; he got through the Lodore canyon with them; he wanted to get out there, and they were glad to have him go, because he wasn't adapted to that kind of work; he was a city man. Had one man to a boat.

They were rowing with their back to the stream, to the current, when they were in quieter water, and sometimes even in pretty bad water, endeavoring to make time.

If they saw a rapid was clear of rocks, even if it had a considerable drop, they would pull downstream, try to make time, and let the water splash. (R: 787–789.)

It would have helped if they had had someone in the stern or in the bow who could have seen ahead. They found many such bars throughout Labyrinth Canyon down through the Double Bowknot section. The Double Bowknot is in the form of a double 'S' and the walls are about seven hundred feet high, he believes. Coming out of Labyrinth they soon got into Stillwater Canyon and the river was more confined. They had a little trouble with sand bars, but not much. Stillwater Canyon runs clear through to the mouth of the Green River. (R. 790–791.)

In that section between Greenriver, Utah, and the mouth of the Green River, met no boats at all. Saw no people, except they saw some engineers working below the Wolverton ranch.

Wolverton had a power boat of which he was very proud; he claimed that he had been to Greenriver with it; he thought that was quite an accomplishment.

He did not see any boats in operation as he went down. There were a few ranchers in the section there where Wolverton's lived but they did not see any dwellings after they left Wolverton's a few hours. (R. 791.)

When they entered the Colorado River it seemed a little higher than at Greenriver and the water was more red. (R. 792.) The rapids began about four miles below there, the rapids of Cataract Canyon, and Cataract Canyon is a little over forty miles in length, and has forty-five bad rapids according to the record of the geological survey. (R. 792.)

They ran every rapid in Cataract Canyon.

They didn't take their boats out of a single rapid, and they have always bragged about it, that they had quite an adventure, and got through without any serious difficulty. (R. 792.)

It is customary, if you are careful at all, to get out above every bad rapid, tie the boat up, walk down almost to the bottom of it, look upstream very carefully to examine the rapids; in that muddy water, looking upstream, one can locate the hidden rocks by the action of the water; looking downstream it is very difficult to tell whether it is a rock or whether it is just a wave caused by a deep rock. Would then try to remember where those

rocks were, and sometimes they would go back two or three times before they could satisfy themselves that they would remember the channel.

He and his brother actually examined these rapids in Cataract Canyon before they ran them, in every bad rapid, and would make about ten miles a day through those rapids for the reason, that they were spending most of the time on the shore examining the rapids.

They were there to get pictures putting their boats through violent water; that is what they wanted, some motion pictures. The game was in its infancy then, but they had a camera, and were making motion pictures of shooting rapids for the thrill they would give. It was a sporting event. (R. 793–794.) Hoped to make some money out of it. (R. 793–794.)

After they got out of Cataract Canyon there was a short canyon called Narrow Canyon and it is approximately one hundred eighty miles from the end of Cataract Canyon to Lees Ferry. Lees Ferry is seven miles south of the Utah line by the river. There was quiet water in Narrow Canyon. It seemed very quiet and they had to pull hard downstream to make progress. (R. 794.)

Frequently they would get on a bar or an island which did not come above and there would be a channel on either side but he doesn't remember that he had difficulty in grounding on sand bars or crossing bars. Narrow Canyon is about six miles long.

Directly below Narrow Canyon the Fremont River comes in; sometimes called the Dirty Devil. (R. 795.) This is before you get to Glen Canyon; the recent survey includes Narrow Canyon in Glen Canyon. (R. 796.)

In Glen Canyon they experienced difficulty in grounding frequently. The mouth of the San Juan is a little more than halfway through Glen Canyon.

Below the San Juan the river is quieter than above but there is considerably more sand brought into the San Juan and their progress from that point was marked with groundings frequently. (R. 796.) They made the run to the mouth of the San Juan in possibly three and one-half days, he believes.

The Hole-in-the-Rock is above the San Juan and the Crossing of the Fathers is below. (R. 797.)

That section of Glen Canyon had canyon walls set back from the river and the canyon was possibly one thousand feet wide and there were bottoms on either one side or the other. There were bottoms four hundred feet wide that had dense growth of willows and vegetation; very few cottonwoods, and there were more cottonwoods in the upper section. Glen Canyon ends at Lees Ferry. (R. 798.) Same character of water through all that section. The lower end is quieter than the upper section. (R. 798–799.)

Hite, Utah, is a short distance below the mouth of the Dirty Devil, just a few miles, and they saw

three men in that section. There were three separate cabins within a few miles of each other. Two were on the right side of the river. One was John Hite and his brother Cass. On the other side Bert Loper had his ranch. Bert Loper was working with a boat. He was placer working and had his little cabin and a few head of stock. He wasn't at home. They stopped with John Hite that night. He had a Post Office there and the next morning Loper hailed them from the shore, possibly a little below his home.

When they speak of bad rapids like in Cataract Canyon and the Grand Canyon, they mean rapids where they are likely to strike a rock and smash their boat completely in two. That has happened with many; and rapids where a man is likely to be thrown out and not have any chance at all of saving his life. He is lucky if he gets out in those cases.

When they came into Glen Canyon, the rapids they found there did not impress them as being those kind of rapids. There were four rapids that stand out in his memory in Glen Canyon as being what they would call master rapids; they had shallow water, rocks close to the surface, all the way through; they would not make great waves that would swamp a boat; they would make jumpy water all the way through possibly for a quarter of a mile, and the boats were frequently dragging on the rocks; the water would force them through,

through its own power; the boats are buoyant to a great extent, and while they were heavily loaded, water would force them right through, and their oars were continually striking these rocks. They weren't big rocks, sticking above the surface. One of those rapids is called the Bull Frog Rapid; another is close to Halls Creek, and another is called Bed Rock Rapid; the water pocket fold there is close to Halls Creek, and then there is a rapid below Bridge Canyon. (R. Vol. 5, pp. 803–804.)

Bull Frog Rapid was just below the mouth of Bull Frog Creek in Glen Canyon, another rapid was at the water pocket fold which is above the Escalante River. Another rapid was located as being at Hall's Creek and another at the mouth of Bridge Canyon, about eight and one-half miles below the mouth of the San Juan River. (R. 805–806.)

Besides the rapids mentioned there were other places where the water would speed up that he called riffles. Beyond the last rapid, trouble with grounding and running into sand bars was experienced down as far as Lees Ferry. (R. 806.)

From the last rapid to Lees Ferry boats would ground; they would run on to sand bars which would check their speed; had extra oars on the deck of the boat; would loosen one of those and use that as a pole and try to push back upstream, the same

way they had come in; they would stop them for a while; would try to get back, and judge by the action of the water which way the current was going and which way it was turning, and try to follow that current. (R. 807.)

He used Dellenbaugh's "A Canyon Voyage" as a guide book. He continued on down the river below Lees Ferry.

They left Green River City, Wyoming, September 8th, Friday, 1911. Arrived at Greenriver, Utah, on October 16th. (R. 809.) He stopped two days at Lodore, four days at Vernal and Jensen and left Greenriver, Utah, October 19th, 1911. He arrived at the mouth of the Green River October 25th, 1911, and left the mouth of the Green River October 26th. (R. 809–810.) Arrived at Lees Ferry November 6th. (R. 810.)

He does not believe it possible to take a boat upstream against the rapids in Glen Canyon he has spoken of. (R. 811.)

The second trip down the Green and Grand rivers made by him was in the interests of the Southern California Edison Company and the United States Geological survey. This expedition started from Greenriver, Utah, September 11, 1921. Because of his experience on the river he was hired as boatman. Other members of the party were Wm. R. Chenoweth, topographic engineer; Sidney Page, geologist; E. C. LaRue, hydraulic engineer; Leigh Lint, rod man; John Clogston, commissary

cook; Harry Tasker, rod man; Emory C. Kolb, photographer. (R. 812–813.) He was the boatman of that party in charge to handle boats through the rapids. That is what he was principally there for. (R. 813.)

Henry Rauch, an assistant to Emory C. Kolb, and Frank Stout, an employee of the Southern California Edison Company, were also unofficial members of the party.

Reverting to his first trip, he explains that Julius F. Stone, who had made a trip down the river in 1909 in company with Nathan Galloway, gave him the plans of boats used on that trip and the boats used by witness and his brother were made after the plans submitted by Stone and built in Michigan, from where they were shipped to Green River, Wyoming, by rail. The only difference in the construction of the boats used by him and the Galloway type boat used by Julius F. Stone was an amplification by addition of decks. (R. 814–815.)

Approximately three hundred pounds of supplies were loaded in the boats, which, together with photograph equipment, the weight of the boats and the compartments totaled about twelve hundred pounds per boat. (R. 815.)

Provisions for the trip would be approximately three hundred pounds; then they had their beds, and their photographic equipment was heavy; all supplies and equipment would weigh six hundred pounds. (R. 815–816.)

The supplies and equipment taken was all that could be carried in the boats. The boats used on the second trip were larger than those used on the first, but were of the same type.

The boats were loaded as lightly as was consistently possible in order to make the trip, because of the danger in running rapids and encountering bad water.

The boats on the second trip were three in number, two of the Galloway type and one of a type recommended by the people at Wilmington, California, who constructed the boats. The two Galloway boats were eighteen feet long with four and one-half foot beam. The third boat was built on somewhat different lines and was about fifteen feet long. The approximate cost of the two larger boats was four hundred dollars each while the third boat cost one hundred fifty dollars. (R. 816–820.)

The boats used by the Kolb brothers on the first trip cost two hundred twenty-five dollars each. The boats were all flatbottom.

Including the weight of the boat and the oarsman, they weighed 1,200 lbs., had draft of 8 inches, with a load of 1,200 lbs.; never weighed those; guessed at it pretty much; weighed the boats when they were absolutely dry, and they weighed five hundred pounds; and their own weight, and just guessed at the weight of the provisions. Actually weighed the boats; it was in the bill of lading. (R. 820.)

On the second trip Mr. LaRue and Mr. Page left in one of the boats on September 11, 1921, for the purpose of making certain surveys down the river before the rest of the party left Greenriver; the balance of the party following the next morning. The party left Greenriver in one of the large boats and the smaller boat, in which they carried a small out-board motor for the purpose of attaching whenever they chose to. This motor was of a type such that the propellor reached about eighteen inches beneath the bottom of the boat and was hinged so that if the propellor struck bottom it would rise up behind the boat and release itself. The motor was attached to the boat about half a mile below the Green River and the larger boat was fastened alongside so that the one out-board motor acted as motive power for both boats. (R. 820–822.)

Some trouble was experienced by the boat running into rocks and scraping bottom, which caused some delay. Trouble of this type occurred many times on the trip but was not taken much notice of because such accidents and stops were considered incidental to the trip. No damage was done to the boats because of striking or scraping rocks but oak strips were put on the bottom of the boats in order to prevent extra rubbing and causing of leaks.

Most of the trouble from striking bottom and rocks occurred in the first twenty miles of the trip and was due to shallow water, not to sand bars.

Good time, however, was made with the use of the motor. (R. 822.)

His notes state that he had located the Wolverton ranch a short distance below the San Rafael; passed the San Rafael on this second trip—they are written in pencil, and they got wet, so they are not very legible; passed the San Rafael River at 2.45; Wolverton's old ranch was abandoned, or the house was closed; just below, on the opposite side passed Twin Alcoves, a place mentioned by Dellenbaugh in his book, at 4.10; camped at 5.45 on the right side, an hour's run below Twin Alcoves. (R. 822-823.)

After leaving the mouth of the San Rafael his notes read: "Tuesday, September 13th; morning brisk, cool; started at 8.00 a. m.; struck one sand bar at 8.30." That is the only note he made. Didn't make a note of those incidents of getting on sand bars; as a rule; that was just incidental to the work. It was what they call quiet water. They were trying to make time, and they annoyed them. Would sometimes have to get out of the boat to lighten it, and lift it and pull it around, and would climb in again; would tamp around with a stick in the deeper water, or judge by the current; simply said he made a mistake, if one missed it and the other didn't; it was a joke on him. That is the note he made, "Struck one sand bar." (R. 823-824.)

Trouble was encountered at the Double-Bowknot, which was reached at 10.55 A. M. on the second

day. Similar trouble was encountered in Labyrinth Canyon where the out-board motor was taken off the boat because of such trouble and because the speed of the boat with the use of the motor was too fast to change the course of the boat quickly enough to follow the ever changing and twisting channel or to prevent running on to sand bars. (R. 824-825.)

Did have trouble with the sand bars in Labyrinth Canyon. This motor he speaks of, was on a hinge, or was arranged so when they would run on to anything it would come up, and it wouldn't injure it. But had difficulty frequently of that kind, because their speed was greater than it was with the row boats, and sometimes knew there was a channel, but didn't have a chance; it wouldn't steer quick enough to make that channel; it would want to go ahead in the straight channel—wouldn't make the turn quickly enough, and would run on to a sand bar. More often, though, it was because didn't know just where the channel was and where the deep water was. In this Double-Bowknot that he speaks of, there are raised centers in the river, the sand bars protrude above the river; they make islands, covered in high water; there is no growth on them, just sand. That is true through Labyrinth Canyon, a great part of that canyon.

In Stillwater Canyon had trouble with the sand bars; not as much as they did in Labyrinth Canyon. Overlook his brother with his boat below the Double-Bowknot, and attached his boat to the other

side so had a sort of a raft, you might call it, three boats side by side; they were all propelled with this outboard motor; didn't use oars, at all. (R. 824–825.)

So had a boat about between twelve and fifteen feet wide; and once in a while he would loosen his boat and drag it behind the other two, for the sake of making motion pictures from the deck of the boat, of their progress, and would get their boats in the pictures; then would come back to his position at the side of the boat. Have one motion picture made where they ran onto a sand bar and had considerable difficulty in Stillwater Canyon getting off and finding the deeper channel, but didn't have as much trouble there as they had in Labyrinth, because the river is confined by walls which come pretty close to the water, it didn't give it the opportunity of meandering; does not know that there are any islands sticking above the water in Stillwater Canyon. (R. 825–826.)

Similar trouble was encountered in Stillwater Canyon, though not as much as in Labyrinth Canyon.

The party arrived at the mouth of the Green River September 15th and camped just above the junction. The junction was passed at an early hour September 16th and the survey commenced.

Slow progress was made from that time on and he does not remember encountering any difficulties between the mouth of the Green River and Cataract Canyon. It was in this stretch of river that

the boats were separated and the outboard motor taken off the smaller boat.

None of time between Sept. 11 to 16th was taken to make surveys; that part had been surveyed. (R. 826.)

Between Greenriver, Utah, and the mouth of the Green River in a few cases would remark, his brother and himself, that formerly in 1911 the river had a channel at that point, and later in 1921 sometimes that would be sticking far above the water, and it would be a new channel. The river had a permanent bed for high water, and after the water had receded it would not be on that side of the river at all.

By permanent bed he means it is a channel where nothing grows, where there is no vegetation, nothing but sand, and every evidence that the high water would fill that bed from bank to bank, and then when it recedes picks out sometimes a channel in the very middle, with two islands, one on either side. Sometimes there would be an island with just a very shallow between, and a deeper channel on the other side. It had a chance up in Labyrinth Canyon to meander, to work from side to side considerably, and there was every evidence of shifting channels there. They always expected to find deep water if there were short loops or turns in the river close to the outside of the loop. They were nearly always correct in finding a channel at that point. And Desolation Canyon has more of that than any other place—goosenecks they call them, where it is winding back and forward. They would pull

downstream, keeping very close to the vegetation, sometimes they could reach it with the oars, because they knew that was the only channel for good swift water, and then half a mile ahead they would see it turned to the other side of the river, and their only difficulty was in finding the channel; they connected one loop with the other, and there is every evidence that those channels fill up with silt, and the water caused by driftwood or rocks, occasional rocks or something, would be dammed up or stopped, and it would change its channel over to another place. Water always does that.

It is their own knowledge and supposition that the channel between these bends is continually changing; it fills up with its own silt.

Major Powell called those rapids in Cataract Canyon cataracts because they were big, violent water, lots of rock, and he would run one boat through a rapid, tie the others up at the head of the rapid, get down into quiet water below the whirlpools, where he could make a landing, and would walk back along the shore and run a second boat through. His brother frequently would be on the shore making motion pictures of the action of the boats in the water, and in most cases he would run a third boat through in the same way. His brother, if he wasn't busy making a picture, would run his boat through. His was the same boat he used on the first trip, repaired, and on twelve occasions he helped him with one of his boats, usually this light boat he speaks of.

They adopted the Galloway method of coming through those rapids, that is, stern foremost; almost invariably, if the rapid had rocks in it, would use that method, because it gives a lot of satisfaction to see the danger that is directly ahead; you are not looking over your shoulder and just getting a half idea of what it is; you can see it; if you are strong enough, you can turn the boat part way and pull it into a new channel and avoid the rocks. His brother's boat was a fourth boat. He had one of the boats they had used on their first trip. (R. 827–830.)

The water in Cataract Canyon was at about the same stage as when he made his first trip in 1911, probably six inches higher. Some of the rapids had different channels; that is, there wouldn't be as much water on one side as there was on the other. The rapids had changed little, if any.

He had with him notes which were taken on his first trip and from these notes he was able to determine exactly where they were located and to determine where the rapids would be.

Equipment and supplies that could not be stored in the compartments of the boats were carried around some of the rapids. (R. 830–831.)

Followed same method on first trip; did that in many cases; they would take two-thirds of the stuff out of the boats and carry it around to make the boats easier to handle, and to make them so they would have the stuff saved in case lost the boats; that was always in their minds in these rapids. (R. 831.)

Only one of the rapids in Cataract Canyon was lined although it is his opinion that good judgment would be used in lining lots of them.

There is a rapid at Dark Canyon similar to one or two others above, but it is a very bad rapid, and they had run that rapid on their former trip; it didn't look any worse than lots of the other rapids that they had gone over with their boats. (R. 832.)

There was one of these islands he speaks of that projected above the water, or sand and rocks, not gravel, but rocks, projecting above. On the south side, pretty close to the south side, it was in sort of a shoestring shape, that is, a very long, narrow piece of high land in the middle of the river, or above the water, and it wasn't continuous; sometimes there would be a little water connecting parts of it. The rapid is in the shape of the letter "S." He looked it over quite a long time, and at first thought he would try to run it on the south side, but gave it up because there was not sufficient water there. In many cases he would pick out a very narrow channel where he knew the boat would just slip through, the width of the boat would just get through, sneak through, instead of picking the big water out in the center of the river. First he thought he might get through on that channel, but gave it up, then attempted to run one of the larger boats through on the north side—northwest side, it would be—and he was very much afraid of a very sharp bend close to the lower part of the rapid; he had to pull away from the shore; he didn't want to

get carried into that bend, because the water ran over a great rock right at the point, and he knew it would upset the boat if he got into it, and in endeavoring to avoid that he pulled too far, and the boat was thrown up on one of these islands where the water was crossing between, and was held on the rocks. (R. 833.) At first it was level, and then the water running over the stern shoved that end down, and the other end up, and he was marooned about fifty feet from the shore. The engineers were on the south side of the shore, and after a few attempts managed to throw a light line to him, and pulled a heavier rope across; they attached that to the painter, or the line attached to the bow of the boat. He wanted to keep it from getting dragged under, and secure it in case it would swing loose of its own accord. After pulling on the rope, attempting to pull it loose, they gave it up and made motions for him to come to the shore—one can not hear anything above the roar of the rapid. They wore life preservers, he held to the rope; they elevated it as high as they could, on the shore, with logs; he hung to the rope with his legs and his hands, and pulled himself across; the rope sagged down into the water; the force of the rapid almost pulled him loose, but he managed to get to where the other men on shore could reach him and help him with their hands. The boat remained there all night, lot of valuable material in it, some of the maps of the survey, and he knew it was in the part that was projecting above the water.

His brother made a pulley out of a cottonwood log to run on this rope, and the next morning he was pretty much worn with his work through Cataract Canyon—believe he lost fifteen pounds in weight, handling the three boats. (R. 834.) He was a little fresher than his brother; he (witness) was the first out to the boat, using this pulley going out; he (witness) followed; they tacked canvas around the cockpit, this open part, so the water wouldn't run in; baled that part of the boat out; that made the boat lighter; and then tacked canvas around the hatch cover that was underneath the water, and excluded the water from running in, and we baled that part out. Then they took the material out and attached it to this pulley, and the men on shore took the material to the shore in that way. The maps were the first things that were sent ashore; they were dry; there was very little lost from anything getting wet.

The boat was on that rock for twenty-four hours. He still thought he would run the rapid. He took all the material out of the second boat, and if you can run a rapid with a boat you are through in a very few minutes. If you take the boat out—if you carry your stuff—it takes practically a day to do it; there is a great temptation always to run the rapid if one can. (R. 835.)

Took the chance in almost every case, of running a rapid, if there was any possible chance for it. He made a second attempt; got too close to the shore; this place where he speaks of water running

over the rocks; that boat they overturned; had life lines around all boats; had drilled ourselves in it; when a boat overturned always caught the life line; as went over, he held, and the boat drifted into quieter water; some of the men on shore came down, threw a life line to him; he was pulled to the shore. He made a third attempt with the next boat, overturned with that, and the man had this other boat empty, and came out and pulled him ashore. All three boats were at the end of the rapid; none of them were broken. Advised his brother to line his boat, and that was done; he didn't attempt to run his boat. With three upsets, three boats, they got through.

On the right shore at this particular rapid the banks came very close to the rapid, and then there was a steep talus slope of rock that came right down into the water. (R. 836.) On the south shore—on the left shore, there was quite a wide sand bar—gravel bar and rocks mixed in with it. It was muddy from high water, silt in it, that a person steers into very easily; it is nasty stuff to get through; you sink in it to your ankles, on account of its being wet, mixture of quicksand, silt, mud, sand, and rocks. (R. 837.)

In lining a boat through the rapids the boat is maneuvered by means of ropes tied to the bow and stern while the boatmen are on the bank. A portage is made by actually dragging the boat out of the water and carrying or transferring it along the pole past the rapids.

The boats used by him on this expedition were too heavy to carry, so that logs were used as rollers and the boats rolled past the rapids where portage was made.

Orders were given that life preservers should be used in running all rapids and none of the men were allowed to ride the boats during that time. With the exception of the rapid near Dark Canyon, which is the last bad rapid in Cataract Canyon, no serious trouble was encountered with rapids. (R. 837-838.)

As a conservative estimate, some of the waves at the rapids would be twelve feet high. You could take the level of the river, it went up twelve feet above that level. Below the wave there is a hollow place; you can get twelve feet from the top of the wave to the bottom of that hollow place.

In taking the boat through, it is necessary to hit that wave head on. There are not so many of those in a rapid, two or three, and they would endeavor to keep a straight course in going through those; then if we had to avoid rocks, try to get some place where the waves weren't so large, and turn quartering to the current and work out of that channel into a new one.

In going through a rapid of this character, you invariably get water in your boat; lots of times the boat would fill—the open compartment would fill instantly with one of those waves; they would be seated in water clear up to the gunnels. (R. 839.)

The rapid at the head of Narrow Canyon, about a half mile below Cataract Canyon, was much worse on the second trip than on the first trip. This rapid was run, however, and Mr. Lint, who had had considerable boating experience on Salmon River, handled one of the boats. Tasker possibly took one of the boats through.

After passing through Narrow Canyon, the party stopped for the night at the John Hite ranch, about eight miles below the Dirty Devil River. After they had stopped, four cattlemen came to the cabin, one of whom lived there and ranged cattle in that section. At this place there were bottom lands on the banks of the river and a road or trail leading up to the mesas. (R. 840.)

From John Hite's ranch down to the mouth of the San Juan, LaRue and Page took one of the boats and the other boats were handled by the balance of the party. Considerable trouble was encountered because of sand bars—there were lots of sand bars. It was always a guess as to where the channel was located and its location could not be told from appearances of the water. The channel of the river on this trip had changed from where it was in 1911, according to his memory, although he did not pay much attention to it. (R. 841–842.)

The outboard motor was tried again unsuccessfully. The larger boats on this trip weighed from eight to nine hundred pounds light and between sixteen hundred and two thousand pounds loaded.

This weight, of course, would decrease as the trip progressed because of the use of provisions for subsistence. In addition to the weight of the boat and supplies, the weight of the men carried should be added. A boat carrying three men would make the total weight from two thousand to twenty-five hundred pounds. As a rule not more than one man would be in the boat at a time; sometimes two or three were carried, but only in crossing the river back and forth during the survey.

The survey party continued on down to Hall's Crossing, where the party split, the engineers remaining behind. (R. 842-844.) Stopped at Hanson Creek. Mr. Chenoweth had cache here. Began surveying back from the canyon.

His notes read: "Tuesday, October 4th. I took the Static; LaRue in the Edison",—that is the name of another boat, and one boat was called Static, the small boat. Met above Halls Crossing by Tom Wimmer, at 11:15, in the motor boat. (R. 845.)

Wimmer freighted some supplies in for the engineers at Halls Crossing, and he had a motor which he had put in the boat, and he came up the river and met them a short distance above Halls Crossing, and he took LaRue on board because they had worked together, and they went up the river to look at a certain rapid that they had talked about

before; he doesn't remember what rapid it was; they just went up to look at it while we went down and took on a load of supplies.

Mr. Wimmer freighted the load of supplies in by wagon over the rough roads to Hall Crossing; that is at the mouth of Hall Creek, or very close to it.

Then unloaded Mr. Chenoweth's surplus and loaded up with fifteen hundred pounds of supplies for Trimble, another engineer connected with the survey further down—connected with the San Juan survey.

Wimmer met him a very short distance above the point where he (Wimmer) reached the river. He would say he was a mile above his camp, very short distance above the camp.

He, Wimmer, had a little joy ride up to the foot of the rapid. (R. 846.) The boat was empty.

He brought supplies from Greenriver, or from one of those towns up north, by road.

Wimmer is a river man; he has always got boats scattered at different places; he is always experimenting.

No supplies were taken up the river, they unloaded Chenoweth's surplus so he could take it up by wagon, so Wimmer could take out certain surplus supplies that Chenoweth didn't want to be bothered with. (R. 847, 848.)

The mouth of the San Juan River was reached October 5th at 2:30, where Trimble's party was found. One boat with supplies was left there with Mr. Trimble's party and he [Kolb] with the balance then proceeded on down to Lees Ferry. Those accompanying him were Mr. Page, Mr. Miser, who joined the party at the mouth of the San Juan, and Mr. LaRue. One of the boats had formerly been left with Mr. Chenoweth at Halls Crossing. Fifteen hundred pounds of supplies were hauled on the two boats from Halls Crossing to the mouth of the San Juan. (R. 848-850.)

Trouble with sand bars was encountered on the trip between Halls Crossing and the mouth of the San Juan, and the boats would sometimes have to be pushed off the sand bars; and the boatmen took turns in getting out of the boat into the water and pushing them free. This had to be done a number of times by each.

From the mouth of the San Juan down to Lees Ferry, trouble with sand bars was encountered frequently, as a matter of fact, most of the trouble encountered on the trip was had at this section of the river. Most of these sand bars occur between the mouth of the San Juan and the Utah line. As Lees Ferry is neared, the water becomes deep and the sand bars fewer. (R. 850-852.)

One rapid just below Bridge Canyon occurs in this section of the river between the mouth of the San Juan and the Utah line. Other points where

rapid water was encountered were called riffles by him because they looked somewhat smaller to him in comparison to the cataracts that he had run. (R. 852-854.) If they hadn't run those—the dangerous water—they would have called lots of boat and fill it—they called those rapids; these others, where the waves were a foot high—they would be running fifteen miles an hour—they would call them riffles. (R. 853-854.)

They would make a difference in the height of the waves, where they found waves just about a foot high and hundreds of those jumping up and down, they would call that a riffle; it gave evidence of small rocks just under the surface of the water; they could take the steering oar and touch rocks most of the way through those places; they weren't big rocks that would make enormous waves that would throw the boat from side to side and almost swamp the boat, water that would break over the boat and fill it—we called those rapids; these others, where the waves were a foot high—they would be running fifteen miles an hour—they would call them riffles. (R. 853-854.)

The party arrived at Lees Ferry Saturday, October 8th, 1921.

The barge which he had seen under construction on his first trip down the river in 1911 was not seen on this trip.

On the trip from Greenriver to Lees Ferry, he [Kolb] saw a

survey party working at the mouth of Escalante using a boat, and at Hall's Crossing another party using a canoe. The party using the canoe had been using a flat-bottomed boat with outboard motor, but he had abandoned the motor boat because he was more used to handling a canoe. The flat-bottomed boat was being used by Mr. Hough's party above seven and one-half miles above Lees Ferry. Mr. Joekel, a member of the Coast and Geodetic Survey, also had rowboats.

The only settlers or ranchers seen on the trip were the four cattlemen at John Hite's ranch (R. 854–855.)

He has never been from Greenriver to Lees Ferry overland.

He, together with Bert Loper, made a trip on the Grand River in a Peterboro freight canoe from Glenwood Springs, down to Grand Junction, and on down through Westwater Canyon, which is a short distance inside the Utah line.

Previous to this trip he made another trip with John Shield in the same canoe but on this trip the boat was hauled around Westwater Canyon. This trip was made in 1916. (R. 855–858.)

The first trip he made on the Grand River was as far down as Moab, Utah; this trip down the Grand commenced at Delta, Colorado, August 18th, 1916. In Westwater Canyon, the canoe was taken out of the river and portaged around to the end of the rapids. They then continued on down the Grand

River to a point below the Rio Grand pumping plant that furnishes water for the station at Cisco.

The canoe was eighteen feet long, three and one-half foot beam, weighed about two hundred pounds, carried a load of not over three hundred pounds, excluding the men, and it drew four and one-half inches of water loaded, including operators. (R. 858–861.)

From the Cisco pumping station down to Moab, sand bars and swift water, silt and quicksand, were encountered; the canoe getting stuck on the sand bars as usual. When the river enters the canyon it has a more rapid descent and numerous riffles occur in these places. The water is shallow and the oars would drag bottom. The canoe was traveling fast and difficulty in making the run through the swift water without striking the shore was had time after time. This condition of swift, shallow water commences about twenty miles below the Cisco pumping plant and continues on down to a short distance above Moab. (R. 859–862.)

There were a few riffles in the section where Dolores River enters the Grand River and he stopped at a ranch near the Dolores River on the first trip.

The run from Dolores River to Moab was made in a day and a half, according to his memory. Complete notes were not kept after getting out of the swift water.

He arrived at Moab about the 25th of August, 1916. Upon arrival at Moab the canoe was shipped back to Thompson by automobile truck and from

Thompson it was shipped by rail to Glenwood Springs.

On the second trip he was joined by Bert Loper and they came down the river from the mouth of the Eagle River to Cisco, Utah. It was on this trip that he with Bert Loper, ran the Westwater rapids. He made the trip for the purpose of taking motion pictures. (R. 863–865.)

Compl. Exh. No. 103 identified as photograph taken at the mouth of the Dirty Devil River. (R. Vol. 5, p. 866–867.)

Compl. Exh. No. 104 represents quiet water at Cataract Canyon between rapids.

Compl. Exhibit No. 105 shows difficulty had in the Dark Canyon rapids when the boat lodged against rocks for twenty-four hours.

Compl. Exhibit No. 106 shows boat in typical Cataract Canyon rapid.

Compl. Exhibit No. 107 represents a rapid similar to Dark Canyon rapid and shows the water swinging first to one bank and then the other.

Compl. Exhibit No. 108 shows driftwood in the river at high water in vicinity of rapids twelve and thirteen.

Compl. Exhibit No. 109 represents rapid twenty-one in Cataract Canyon.

Compl. Exhibit No. 110 is taken looking down stream at rapid twenty-four, about the center of Cataract Canyon.

Compl. Exhibit No. 111 shows rapid twenty-three, and was taken in 1921.

Compl. Exhibit No. 112 represents rapid twenty-three in Cataract Canyon and was taken by him on his first trip in 1911.

Compl. Exhibits No. 111 and No. 112 are photographs taken from opposite sides of the river, and were compared and identified by large, protruding rock.

Compl. Exhibit No. 113 identified as very violent rapid between number thirteen and twenty-three.

Compl. Exhibit No. 114 taken where party climbed out a short distance above the junction of the Green and Grand rivers.

Photograph Compl. Exh. No. 115 represents the Buttes of the Cross in Labyrinth Canyon.

Picture Compl. Exh. No. 116 depicts difficulties had at upper end of Hell's Half Mile, Ledore Canyon.

Compl. Exhibit No. 117 represents one part of Triplet rapid in Lodore Canyon.

Picture Compl. Exh. No. 118 represents Ashley Falls, looking up stream.

Picture Compl. Exh. No. 119 represents Ashley Falls looking down stream.

Picture Compl. Exh. No. 120 represents Red Canyon. (R. 867–872.)

On the reverse side of exhibit number 103 is Westwater Canyon in Utah and the other two pictures are in Westwater Canyon up on the inner plateau and were taken from three hundred and fifty feet at least above the river and shows a boat in the rapid. (R. 872–873.)

Three pictures on the reverse side of exhibit 103 identified as being in the neighborhood of Westwater Canyon, Utah, and exhibit 102 in the vicinity of Westwater received in evidence. (R. 873.)

On the second trip through rapids he would go and look the rapids over again; in almost every case, if they impress them as being a dangerous rapid, would tie the boat at the head of the rapid. (R. 874–875.)

No cross-examination. (R. 875.)

Further examination (R. Vol. 5, pp. 875–876):

On the first trip down the river in 1911 he was of the impression that the low stage of water would be the safest time in which to make the trip but since has learned that a slightly higher stage is better. (R. 875–876.)

Direct examination resumed (R. Vol. 5, p. 877):

Compl. Exhibit 15 identified as a book written and published by him after the completion of his river voyage and is a correct recital of the trips made by him upon the river. (R. 877.)

Re-called

Further examination (R. Vol. 5, pp. 955–958):

On trips he made he had the maps supplied by the Geological Survey. He can not say what year they were issued. (R. 955–956.)

The map used on the first trip in 1911 was from the records of the Powell survey and was not a complete contour survey, only an approximation and inaccurate in many places. A complete survey by the government was completed about 1921. (R. 956–957.)

A map of Labyrinth or Stillwater Canyon was never used as aid in avoiding sand bars; never used them in that respect; used them only to locate their camps and prominent landmarks which they expected to reach ahead of them, to get a knowledge of the country that was ahead, before they reached it, because they didn't know the country.

Never used maps for the purpose of operating the boats; they got their information in that respect, concerning rapids, from Dellenbaugh's book.

His answer is the same on the stretch between the end of Cataract Canyon and Lees Ferry. (R. 957.)

The detailed maps issued by the Topographic Survey would give a lot of previous knowledge; they would accurately locate the rapids before they reached them; the survey party accurately located the rapids they found.

He never knew such maps located sand bars; didn't know there was such a thing attempted, but he does know they located the permanent rapids, and they were nearly all permanent. If they

charted the sand bars they would be of assistance. (R. 957–958.)

HENRY E. BLAKE

For Complainant

(Record, vol. 5, pp. 878–955)

Resides at Monticello, Utah; 32 years of age. Has followed newspaper business as a printer, surveying as a rodman and recorder; has had high school education; was boatman for U. S. Government survey parties. Has had experience boating on Green, San Juan, and Colorado Rivers. (R. 878–879.)

Made a trip with father in gasoline launch from Greenriver to Moab, Utah. 1921 acted as boatman on dangerous parts of San Juan River for U. S. Geological Survey. (R. 879–890.) Handled second boat. (R. 880.) Boats brought by truck from Greenriver, to Bluff and launched at Bluff. (R. 880–881.) Flat bottom, 16 ft. long, 4 ft. wide; draft 3 inches unloaded. Loaded with provisions and passengers, draft 12 inches. (R. 881–882.)

Took one boat through the Narrows below Mexican Hat; waters swift and hard vigorous work. (R. 884.)

Rowed boat back and forth across the river, and next trip with boat through canyon above Clay Hill Crossing. Boats loaded not over six hundred pounds to the boat. Water not at flood stage. Another time took a boat through a small rapid. Boat struck a rock and split from stem to stern; in his

opinion faulty construction of the boat. Repaired on the spot. (R. 885-887.)

Operated boat carrying engineers across river near Clay Gulch; heavy sand waves 3 or 4 ft. high; went through rapids Piute Creek or Canyon; went through rapids eleven miles above mouth of San Juan; portaged around this rapid; river bed was choked with boulders, quite large rocks, banks first sandy beach, then drift-strewn, boulder strewn body of ground. (R. 888.) Dragged the boat by man strength. (R. 889.)

Numerous sand bars encountered some stretches of river above Clay Hill Crossing, above and at the crossing. In boating rapids provisions portaged around when boats were portaged. (R. 889-890.) Last stretch of river many sand bars. Saw no boats other than those of party. Saw no placer miners.

From mouth of San Juan River he and Bert Loper took two of the boats to Hole-in-the-Rock, distance 4 or 5 miles, and returned to camp. Survey continued to Lees Ferry. (R. 890-891.)

Party started from Bluff, 19th of July, 1921, and completed trip December, 1921. (R. 892-893.)

During latter part of July and first part of August, six different floods were encountered; made boating difficult. At foot of Hunaker Bend, flood caused sand waves ten feet high, stopped progress of boats for a day. (R. 893-894.)

Pack train supplied party with provisions, at Clay Hill Crossing. Loper and Miser compelled to drag boat up to cache of supplies and brought it

back to mouth of Flute. Cache of food at mouth of San Juan River left by Mr. Wimmer. Additional supplies from boats of Kolb brothers. (R. 894.) Supplies also came from Lees Ferry to Asher Creek.

Party terminated and went from Lees Ferry to Flagstaff by automobile. Thereafter boat left at Lees Ferry. (R. 894-895.)

First trip on Green River with father in 1909. Made trip with Government survey party in 1922 from Green River, Wyoming, to nine miles above Greenriver, Utah. On San Juan River near Four Corners. (R. 896-897.)

Boats used on Green River trip of 1922 were 18-ft. Galloway type boats with covered decks fore and aft, cockpit in center, five-foot beam, rake of about four inches, flat bottom, nonkeel. Draft empty 4 in. Seven in party, Mr. Trimble in charge. Draft boats loaded with 1,000 pounds, excluding men, draft eight inches. Two men to each boat. (R. 898-899.) He was employed as boatman and as rudman. Work necessitated many stops; night stops for camping. (R. 899-900.)

Fairly low water through Red Canyon; numerous projecting rocks in upper end; sometimes unavoidable and boats would scrape or bump them; one boat ran on rocks, and further down in canyon, the other boat ran upon a rock and was pulled off by boat by taking a half-hitch around the hatch cover; weight of moving boat dragged the stranded boat off rock.

Looked over rapid at Ashley Falls before running. Looked over rapid at Red Creek before running, and stopped above dangerous whirlpool where current of river piled up; jumble of rocks, river filtering through, leaving no channel; boatmen nosed boats around whirlpool; required skillful manipulation to avoid accidents through Red Canyon.

At Cold Point many submerged rocks; water fairly swift; bumped one or two boulders. Then entered Little Brown's Park. (R. 901–902.)

Believes no other boats encountered this strip of Colorado River.

Numerous rapids near head of Whirlpool Canyon, and throughout, until Island Park is reached. (R. 902–903.)

Below Jensen first rapids in Desolation Canyon, encountered a number of bad ones; outstanding rapids being of Hell's Half Mile type; protruding rocks in swift waters in rapids. (R. 903.) Desolation Canyon rapids of small descent but dangerous aspect because of jumble of boulders strewn on stream bed. (R. 904–905.)

Possible in certain stages of water to take a boat upstream in certain stretches above Greenriver, Utah; through Brown's Park and above Desolation Canyon to Ouray and Jensen. (R. 906.)

Between Jensen, Utah, and Greenriver, Utah, bridge, from 1916 to 1928, great number of changes in Green River; banks have been washed away; river changed course; number of sand bars de-

stroyed which showed in low water. River wider and shallower near mid Spalding place, 2 miles above Stevenriver and at Sawyer place. With outboard motor propeller hit bottom hard at these places. (H 907-908.)

At Sawyer place river has changed channel cut through a former island, that does not now exist only in high water, formerly had narrow gravel bottom with swift water. Impossible to get boat through except near shore in September, 1929. (H 908.)

From Sawyer to Booth place was swift water, island, divided river, impossible to take boat through either side of island, channel too far for fear of wrecking propeller.

On return trip to Stevenriver found shallow water, difficulty at crossing but above railroad bridge.

Have start at widest point on inside of curve of river, in slow water and where sediment deposit, water always fast outside of curve, river proceeds around the curve and starts to make a curve to the opposite side, water shallow from widest point of bend on one side, straight down to widest point of bend on opposite side, river continually makes these bends. Here is where it is difficult to find channel if there is any. (H 909-910.) Much sand bars found frequently in Steven River. (H 910.)

The boat was a power boat that was used in part of Hoyt trip in 1928.

Water quiet from Stevenriver down for half a mile; motor taken off boat, too much draft for that

stretch of river with a motor. Rock riffle, boat would scrape bottom occasionally. (R. 911-912.)

Below first riffle, river spreads out wide; submerged sand and mud bar on right-hand side; in trying to pick them up got stuck in soft mud; no foundation against which to push, had difficulty getting boat off bar.

Made map of crossing bar; bar did not cross full width of river, left channel on right-hand side; water too swift and when waist deep could not wade to reach bar and make sounding.

Can tell comparative depth in relation to other water by speed and wave action of water. (R. 913-914.)

Large and small island with channel to right, very narrow and swift; took narrow channel; had swift ride. Numerous gravel bars, some typical crossing bars. Seven miles below Greenriver at Little Valley, river spreads, numerous channels and small islands; islands gravel formation and may be submerged in high water; difficult to determine best channel; swift water appeared deepest and took boat through, some places boat dragged bottom and oars dragged. (R. 914-915.)

Landings were difficult to make because of the shallow water near the shores.

Near the center of Little Valley there was an unmapped pronounced riffle, where the boat struck bottom because of shallow water. About a mile below this riffle there is another riffle and gravel bar which had been used as a ford, wagon tracks

leading to it on both sides of the river. On this bar the water was about two feet deep at the deepest place and possibly not over two inches deep above the highest of the gravel in the bar.

At Halverson's ranch, where Mr. Hoyt wished to go ashore, he dared not row the boat to shore because of shallow water, so the boat was held in mid-stream while Hoyt and Moyer waded ashore. There was no one living at Halverson's ranch. (R. 915–917.)

This shallow water continued for a distance of about a half mile and then swift water was encountered, with protruding rocks on the left side of the river. The boat had to be taken through around these rocks. About a half mile below this rapid, very shallowly submerged bed rock extended from the left bank to about half way across the river. A short distance below this bed rock another shallow riffle was encountered; the boat was taken through but the oars would strike bottom.

Near the right bank of the river there was a cliff of cobble rocks which forms deep water, then directly below there is more shallow water and an island. The water seemed fairly deep on the right side of the island and deep enough for a boat on the left side. (R. 917–919.)

The next bad water encountered was called the Auger, at the side of which is a typical gravel riffle. The water runs swiftly southward into the bank

and is deflected eastward, then immediately below it becomes placid with a large sand bar exposed.

Below this riffle for some distance there were long stretches of straight river with shallow gravel in places and a few sand bars. Below this is a riffle known as the Second Anvil; then the river proceeds through the same character of country to the First Anvil, where many sand dunes appear on the right hand side of the river and the water becomes placid. Sand bars are more in evidence than gravel.

Between this point and the Wimmer Ranch, more gravel bars were struck. Just below the Wimmer Ranch, near the old water wheel, the water is swift and is split by an island. This channel must be boated very carefully to avoid striking the bottom. Below this is deep, placid water down to the mouth of the San Rafael River.

Near the old water wheel below Wimmer's Ranch water is swift; split by an island, must be boated carefully to avoid striking bottom. Deep placid water from there to mouth of San Rafael. (R. 921. Could not have taken rowboat from mouth of San Rafael to Greenriver; not even with a power engine in it.

Sonaba riffle, bed rock entirely across river, portions so close to surface, makes riffles on surface. Not swift but dangerous portion of river.

Primary difficulty is finding channel through crossing bars; another difficulty, flood stage of water; might carry boats to unfavorable location or submerge camp; another difficulty, sudden drop,

would leave boats high and dry before could move them; one time barely got boats out before becoming land-locked, wide mud flat between them and the river. (R. 922–923.)

Flow of driftwood menace to motor boats; had to dodge logs, branches, and sticks.

Greatest difficulty was sticking on sand bars. (R. 921–923.) Good many bars in Labyrinth Canyon; especially in low stage of water; some in Stillwater.

Motor attached to boat at mouth of Green River; boat drew nearly 22 inches, caused trouble with sand bars. Proceeded then up Colorado, large motor boat along.

Large motor boat went through the Slide readily. (R. 923–924.) He attempted to go up left shore; shallow water and sand bars, stalled motor; drifted below and went through.

Large boat piloted by Virgil Baldwin from point on Green River to Moab. (R. 927–929.)

Difficulty above the Slide with sand bars and mud islands; with both boats. Used sounding pole to try and trace channel; no channel deep enough in places without propellors and oars striking the sand; that condition continued until immediately below Moab. Large boat, backed down and traced channel of deeper water up opposite shore. (R. 927–928.)

Made a trip from Lees Ferry to Needles, California, as boatman with government survey. (R. 929.)

Cross-examination (R. Vol. 5, pp. 930–952):

Large boat, not stuck on bar half mile below Moab no longer than stuck at other points on river. Had gasoline launch, 24 or 25 ft. long, 7 ft. beam, five or six men in party, first trip on Green River with father as a boy. Carried bedding and provisions, and trip was from Greenriver to Moab and back. (R. 930–935.)

With Hoyt trip, 1928, purpose was to survey river and map sand bars. Surveyed typical bars. When boat would strike sand and was pushed off, did not always map that, too frequent. Boat was not steered on submerged bars. (R. 937–938, 939.)

During the five years he has lived on bank of Green River and on Colorado River, has not been able to get boat back up Green River as a rowboat; would have to pull it up by ropes. (R. 941–942.) Might pole in a quiet stretch, for sport, not for any great distance. (R. 943.)

Mr. Loper made a trip to Lees Ferry from 75 miles up Colorado River from Lees Ferry with 16 ft. row boat down trip and returned on power boat piloted by Mr. Marrs. (R. 950–952.)

Redirect examination (R. Vol. 5, pp. 952–953.)

Made a trip from Green River, Wyoming, to Greenriver, Utah, with some college students one time. (R. 952.)

Further examination (R. Vol. 5, pp. 953–955):

Crossing bars permanent in one aspect; water lowers they are out, extreme low water, several channels through.

Certain types of bar more or less permanent from year to year.

No sand to amount to anything in rapids. (R. 953–954.)

Recalled (Vol. 5, pp. 959):

Never used maps navigating upper stretches of Green River. Some members of party used them to locate where they were, maps were a consolation whether they helped or not. (R. 959.)

R. C. CLARK

For Complainant

(Record vol. 5, pp. 959–988)

He resides at Moab, Utah, is 48 years old and is engaged in the garage and transportation business. The Moab Garage Company, in which he is interested, operates freight and passenger lines regularly between Thompson and Monticello, Utah, and to Blanding and other points in the surrounding country when necessary; also operates between Monticello and Greenriver, Utah. The company has been operating freight and passenger lines since 1917 and automobiles and trucks are used for freight and passenger conveyances. A schedule of rates has been filed with the Public Utilities Commission of Utah. (R. 959–961.)

The company also operates a scow upon the Colorado River, upon which is written Moab Garage. This scow was built in February, 1925, it is seventy-five feet long, fifteen feet wide, three feet deep from gunnel to bottom, the sides being constructed of four-inch plank and the bottom of two layers of two-inch plank. It has a pointed bow and is propelled by stern wheel, driven by automobile motor at first, and later an industrial motor. (R. 961.)

The boat was constructed for the purpose of filling a contract between the Moab Garage Company and the Midwest Exploration Company, an operating company drilling for oil on the Colorado River about twenty miles below Moab. The first contract between the two companies was a written document but was destroyed when the work was finished.

With a capacity load the scow drew about twenty inches of water, the capacity of the scow being fifteen tons; light it drew about four inches of water. (R. 961–962.)

The first contract called for a rate of $1.75 per hundred for material transferred, on a basis of four hundred tons, the material to be transferred from Thompson to Kane Creek No. 1 well. The usual rate per hundred pounds between Thompson and Moab is fifty cents, the distance being thirty-seven miles by truck. The distance to the Kane Creek No. 1 well from Moab being twenty miles, the rate per hundred pounds by boat is, therefore, $1.25. (R. 962–963.)

He has personally been down the Colorado River on the scow. He doesn't recollect having any operating difficulties on the trips which he took; did not strike any sand bars, Virgil Baldwin operated the boat. (R. 963.)

According to his best recollection, the scow cost about seven thousand dollars.

After making the first contract and commencing freighting other freight was transported further down the river. For freight taken to the John H. Shafer well, thirty miles from Moab, a rate of seventy-five cents per hundred pounds was charged; to Lockhart the rate per hundred pounds was one dollar.

He has a record of two hundred nine trips made by the scow but thinks two hundred forty-five or two hundred fifty trips were made altogether. These trips cover a period from the second of March, 1925, until June, 1929. He made eight trips during the year 1929. He thinks they stopped operating about the first of June, but doesn't remember exactly the date they quit. (R. 964.)

It is expected that another well will be drilled and that further freight will be hauled.

He has had experience with nearly all kinds of boats—row boats, motor boats, sail boats; is acquainted with the bed of the Green River between Castle Creek and the junction of the Colorado with the Green. He has been on that stretch of the river in a boat and has had difficulty with sand bars.

He has never transported any freight in the scow from Moab to Greenriver, Utah. The scow has never been below Lockhart Canyon on the Colorado River, a distance of forty miles from the Moab dock. He has been stuck on sand bars in the Colorado River a great number of times but has never been held up for any great length of time. The sand bars in his opinion are generally found in about the same place in the river and except occasionally, can be avoided.

He recalls the boat known as *Undine*, but was not financially interested in it.

The *Undine* was sixty feet long, round bottom, with steam power. He doesn't know the draft of the boat but recollects it as being about eighteen inches. He saw the boat twice at Moab but doesn't know whether the boat made one trip or two. He wasn't particularly interested in it.

On a trip started up the river from Moab to Cisco in 1889 or 1900, the boat got as far as Nigger Bill riffle, where it got sideways of the stream and turned over. For a long time the boat was on the rocks and couldn't get away but he hasn't seen it in the last two or three years. Nigger Bill Creek is about four miles above Moab. He was not on the boat when it was wrecked but saw it about a month afterward.

At Nigger Bill Creek there is a riffle that is fast in high water and shallow in low water; a rock reef crosses the river there.

The *Undine* was owned by a Denver man whose name he had forgotten. (R. 965–968.)

(Compl. Exhibit number 129 marked and identified by him as *Undine;* R. Vol. 5, p. 968–969.)

Mr. Baldwin looked after the loading and operating of the Moab Garage scow. The best success was had in operating the scow during high water. To his knowledge the boat was not operated at night.

If the boat was run through the Slide he believes it would require the use of a capstan and line. They had a line anchored to the Slide which the scow picked up and put on the capstan to pull through (R. 969–970), walk her up. It might go through there empty. (R. 970.)

He helped establish a gauge at Goodrich on the San Juan River for the geological survey but has not observed the river during low water and did not spend much time around Goodrich. (R. 970.)

Cross-examination (R. Vol. 5, pp. 971–979):

Four boats were operated by him on the Colorado River—three power boats and one outboard motor, and the company took whatever business was offered.

Since commencing operations on the second of March, 1925, the oil companies on the river have been supplied with the services of the boats. In all, about forty thousand dollars was paid to the Moab Garage Company for handling freight for

the various oil companies operating below Moab. A schedule of rates for the first operation was filed with the Public Utilities Commission. Rates were charged according to the amount of tonnage hauled. (R. 971–972.)

He had fixed charges for certain services on the river since he began river operations. Had different prices, according to the amount of tonnage hauled down there. (R. 972.)

Aside from freight hauled on the river, the boats also carried passengers and several parties were taken up and down the river to the confluence of the Colorado with the Green.

In his operations he has never paid any attention to the Green River; his work was confined entirely to the Colorado River.

Advertisements inviting sightseers to make trips on the boats were run and some response was obtained. In all, two or three hundred trips were made. (R. 972–973.)

He was manager of the Moab Garage and its boating enterprise, with offices in the garage at Moab, Utah.

During the transportation of passengers and freight on the river there has been no serious incident occur to interfere with navigation.

The largest of the gasoline launches operated is twenty-two feet long and six feet wide and is operated with a screw propeller. One of the other boats is eighteen feet long and eight feet wide, the

other eighteen feet long and four feet wide. (R. 972-975.)

The small boats were used to carry light loads on rush trips.

Defendant's Exhibit number 1 identified by him as the pier at dock number 1. Doesn't know whether the boat in exhibit was a company boat or a Midwest Oil Company boat. The Midwest Oil Company has operated boats on the river between Moab and its wells since it began operations. The Texas Oil Company had one boat operating on the river.

Deft. Exhibit number 2 identified by him as photograph of Moab Garage scow just before the bow was put on.

Deft. Exhibit number 4 identified by him as Moab Garage boat.

Deft. Exhibit number 3 finally identified as same boat depicted in exhibit number 4 but he was not sure as to whether it was a photograph of the Utah Petroleum boat or the boat pictured in exhibit number 4. (R. 975-977.)

He never took a trip on the *Undine*. (R. 977.)

Redirect examination (R. Vol. 5, pp. 979-980):

In December, 1925, and January, and part of February, 1926, when the excitement was on after striking oil in the Shafer No. 1 well, the Moab Garage Company operated regular passenger service on the river for the purpose of taking people down to see the well. Since that time only occa-

usual trips were made as the occasion demanded. (R. 979-980.)

There has been a little transportation of passengers since the drilling operations were shut down. The passengers were carried in the big boat or barge as well as in the launches. There were several excursions down the river in the big boat.

Further examination (R. vol. 5, pp. 981):

He states that oil was struck at the junction of the Green and the Colorado Rivers. Oil men would get their supplies down by boat. The road from Moab to Monticello passes through unsettled high country, LaSalle being about nine miles east of the road. The country between the road and the Colorado River is broken by run-off canyons to the straight bluffs of the bank.

Redirect examination (R. vol. 5, 982-988):

There is no road in Lockhart Canyon but there is a road into Indian Creek. The road to Indian Creek turns off about ten miles north of Monticello and runs through what is called Hard Draw country. Indian Creek empties into the Colorado River.

He has hauled oil-well equipment down Indian Creek overland. The road down Indian Creek does not run as far as the Colorado River, but stops up the stream about fourteen miles. The drilling material was hauled to its ultimate destination at the Ellis well on Indian Creek. (R. 982-983.) It does not extend on down the canyon to the Colorado.

The Utah Petroleum said they built a road down there, but it never was used, to his knowledge.

They intended to boat their stuff to the mouth of Lockhart, and haul it up Indian Creek. That is what they built that boat for; then when they got ready to do that, this boat wouldn't work very good. If was cranky, couldn't handle it in the river, so they had him take the stuff in overland; then afterwards they built some kind of road from their location to the river, intending to move this stuff out that way. It has been moved out by truck. (R. 983–984.)

He knows of the intended road that was surveyed by the Midwest Exploration Company from the Shafer No. 1 well to the Big Bend at Pipe Line Canyon. Big Bend is about ten miles from Moab and is known as the half-way place. (R. 984.)

There are two box canyons; this is a boxed-in canyon here, referring to sheet 19 of Compl. Exhibit 10, between miles 54 and 55, between No. 1 well and Moab. He does not know anything about the maps. (R. 984–985.)

From this point, as indicated on sheet 19 of Compl. Exhibit 10, the survey ran into Pipe Line Canyon, which is a box canyon, and up that canyon to what is called the knolls, which is the highest point on the desert between Green River and the Shafer well No. 1. From the knolls the road would

then have a gradual slope down to the railroad at a point near Crescent, a station on the Denver and Rio Grande Railroad, about six miles west of Thompson. (R. 985.)

The purpose in surveying that road was a location survey, to see—it was a pipe line survey, with sort of a road scouting trip at the same time. There was no real road survey. that he ever heard of. (R. 985.)

The Shafer No. 1 well is on the west side of the river or the right-hand side going down. The Shafer No. 2 well is on the same side of the river about ten miles from No. 1 and there is no road connecting the two wells.

Aside from these two wells there is the Snowden-McSweeny well, opposite Shafer No. 1 well and on the east side of the river, the Lockhart well, which was started at the mouth of Lockhart Canyon right on the river. The Shafer No. 1 well and Snowden-McSweeny well were twenty-one miles from Moab; the Shafer No. 2 well is about thirty miles from Moab and the Lockhart well about forty miles by the river. There was also another well at about fifteen hundred feet north of the Shafer No. 1 well on the river bottom in the canyon, known as the No. 1-A. (R. 986–988.)

Recross-examination (R. Vol. 5, p. 988):

Heavy equipment was taken down the river on the barge. He believes they have taken down loads of fifteen or sixteen tons. (R. 988.)

HAROLD W. C. PROMMEL

For Complainant

(Record vol. 5, pp. 989-1007)

(Record vol. 6, pp. 1038-1040)

Consulting geologist and mining engineer of Denver, Colorado; 42 years old; early schooling Hamburg, Germany. Worked two years on Quito Railway in Ecuador, and the Guayaquil South American Development Company. Worked as a miner at Cripple Creek, Colorado, studying metal mining and Spanish. Spent five years as mine superintendent in Mexico. Spent several months in Columbia University. Entered the University of Denver. Made a geological trip to South America, investigating mines for Republics of Bolivia, Chili and Peru, returning to Colorado School of Mines. In 1923 opened office for himself. (R. 989–990.)

First went to Moab country, March, 1920, geological investigating Moab and Salt Valley anticlines, at Moab and 8 miles east of Thompson. Spent three months in field, headquarters at Moab and Kendrick-Levi well in Salt Valley. In June, 1920, took charge of party making detailed survey of Colorado River structures. (R. 990–991.)

Photostat of plane table surveys made for use in a suit in connection with strip claims was exhibited by him.

Work extended along Colorado River to Lockhart Canyon, Horse Thief Canyon and Indian

Creek; up Indian Creek about 47 or 48 miles, approximately 250 square miles.

The country covered is very arid, and very rough country. Great many canyons. Water exceedingly scarce; water in Colorado may be close, but you may be 300 ft. above it.

During two and one-half months down the river, saw a scouting party from Monticello, and two cowboys. (R. 991–993.)

Made trip by boat early in 1926; later in 1926 did considerable work on the Green River desert, from Greenriver south to junction of Colorado and Dirty Devil (Fremont) River. (R. 993–994.)

The country is divided from top downward in series of benches or plateaus; upper plateau is known as the Green River desert, mainly covered by wind-blown sand and sand dunes; south end considerable cedar timber. Vertical cliff 300 ft. high adjacent to upland, followed by talus slope 400 ft. high, very steep. Makes impenetrable barrier between upland and next bench; next bench called Black Rim; below talus slope 700 ft. high below that Erni country; exceedingly rough, canyons in sandstone. Edge of Erni country approach Cataract Canyon, drop of 1,500 ft.—near this place is the Old Spanish Trail, lower end of trail led from Grand River plateau down to Colorado River, 2½ miles below junction with Green. Further north same slopes and benches go down to Green River. (R. 994–995.)

This country is practically uninhabited, except Joe Biddleton and brother's camp about 60 miles south of Greenriver; few sheepherders in winter time; two or three men at Duchesne Oil Association camp. 20 miles south old uninhabited camp of Wolverton, who was interested in oil placer claims in Elateriate basin in 1914–1915. Wolverton brought small oil rig in overland and lowered over the cliffs on Old Spanish Trail into Elaterite basin. (R. 996.)

The problem of transportation was a part of his professional duties in making an examination and report on the region in the vicinity of Shafer No. 1 well. In making his examination he ran a traverse from the last known Government section corner at Moab, down the Colorado River to Kane Creek Canyon, thence up Kane Creek Canyon to Hunter Canyon, thence along Hunter Canyon to the locality of a supposed corner, thence continued up Kane Springs amphitheater, across the divide between Kane Springs and the Colorado River and down the Colorado. (R. 997–998.)

Another traverse was run from the mouth of Kane Springs to Hurry-Up Trail and took sight shots all along the Colorado River on both sides. The traverse was then run down Indian Creek and sight shots and sight traverse was run to determine the structural attitude of the formations with respect to possible anticlines favorable to the accumulation of oil in commercial quantities. (R. 998.)

During this traverse survey, a drilling site was located and the method of transportation of tools, men, and equipment, was taken into consideration. (R. 998–999.) The result of his investigation was that:

The first oil site was located on the east side of the river. They had figured somewhat on a wagon road—on the possibility of a wagon road down King's Bottom, and thence up, following Kane Springs Canyon to the Kane Springs amphitheater. The divide between Kane Springs Canyon and the Colorado River at one place there is very narrow. They had concluded they would drive a short tunnel through that divide and overcome the seven hundred foot climb they would have to make with a wagon road over that divide. From there they could follow the bench of the Shafer limestone down to the Colorado River and thence to the well location. However, that was not the road of least resistance. In the matter of locating a wild-cat well in what was at that time considered very wild-cat country they had to take into consideration from a consulting standpoint to lower as much as possible all costs in connection with the work.

Had during their survey work, consulted United States Water Supply Paper, Bulletin No. 335 and 336 (1921), which contained maps of the course of the Colorado River as well as profile surveys. Used these maps in order to guide their work through the country. They fitted together the course of the river—the maps were similar

to the newer maps, so that they had a strip map of the course of the Colorado River from Moab down to Indian Creek. Had the north direction on the map we were carrying our traverse in, and checked back and forth the traverse as against the map of survey of the river. From the profile they obtained the information that the maximum fall of the river in that distance per mile was 1.5 feet. This suggested to him, based on prior experience in Old Mexico on the Balsas River, that it might be possible to ship machinery down the river, especially during high-water stages. They had noticed, of course, during their work, and had had during the work, considerable experience with sand bars in the river, during the period of the wild-cat wells and the determination of whether the field was a commercial field. (R. 999–1001.)

He had had previous experience on the Balsas in Mexico and has transported some freight down that river in connection with an oil-drilling enterprise.

It was upon his recommendation that his employers had the Balsas River used as a means of transportation during the wild-cat period of exploration. This method of transportation was recommended because it was the cheapest means of transportation during the exploration period and was more expedient than to have waited to construct a road. (R. 1003–1004.)

Compl. Exhibit number 122 marked and identified by him as a map of the lands west of Greenriver and west of the beginning of Cataract Canyon. (R. Vol. 6, p. 1009.) The blue, purplish lines on the map represent trips that were made by him on horseback during May, 1926, while doing reconnoissance work west of Greenriver to the Green River and Cataract Canyon. The red chalk marks represent trips he believes were made by engineer Heist. The brown marks represent a trip made by Dean Winchester, a geologist of the United States Geological Survey prior to trip made by him (Prommell). (R, 1009–1010.)

Five wells, four deep wells and one shallow well, were drilled in the vicinity of Shafer No. 1, but he had nothing to do with actual drilling operations.

The discovery well, located about fifteen miles from Moab, was first known as the John Shafer No. 1 well but later changed to the Frank Shafer No. 1 well. The Prommel No. 1 well is located just a little south and east of the Frank Shafer No. 1 well. The John H. Shafer well was drilled on an anticline of about seven and one-half miles south of the Frank Shafer well. The John L. Shafer well is about a mile and a half northerly from the Frank Shafer well No. 1. The A. J. Hazelwood well is located at the mouth of Lockhart Canyon. The Prommel No. 1 well and the A. J. Hazelwood well are on the east side of the river; the Frank Shafer

well No. 1, the John H. Shafer well, and the John L. Shafer well are on the west side of the river.

The Frank Shafer well No. 1 was drilled to a depth of about four thousand, nine hundred seventy feet; the Prommel well No. 1 was drilled to a depth of about three thousand five hundred feet; the John L. Shafer well was drilled to a depth of about three thousand five hundred feet; the John H. Shafer well was drilled to a depth of about five thousand, one hundred feet; the A. J. Hazlewood well was drilled to a depth of about five hundred feet. (R. 1012–1014.)

Oil well drilled at French Seep is located on the map as being about sixty-five miles south of the mouth of the Green River and about ten miles west of the junction of the Green River with the Colorado.

A well drilled by the Phillips Company between Barrier Creek and Greenriver is located on the map as being about forty-five miles south of the town of Greenriver and about three miles west of the Green River.

A well drilled by the Texas Company was located on the map as being about fifty miles south from the town of Greenriver and about ten or twelve miles west from the Green River.

Tools and other drilling equipment were taken to these wells by automobile truck from Greenriver, Utah. So far as he knows, none of the material was taken down by way of the river.

According to his recollection there were three or four wells drilled on Gibson Dome in the neighborhood of Indian Creek, about thirty miles south air line from Moab, Utah, and about ten or fifteen miles east from the Colorado River. (R. 1010–1012). Compl. Exh. 123 is map of anticlines in southern Utah, showing roads, courses of rivers and principal mountains. (R. 1012.)

Machinery for drilling the Frank Shafer well No. 1 was moved to the site in the winter of 1924 and actual drilling operations commenced early in 1925; the John L. Shafer well was started in the spring of 1926; the Hazelwood well was started about the same time; and the Prommel No. 1 well in 1927. The John L. Shafer well, the last well drilled, was started in 1928.

In 1926–27 there was a well drilled on the San Juan anticline near the San Juan River, another on Cedar Mesa north of the San Juan River and another north of the San Juan on the Elk Ridge. With reference to Bluff the Cedar Mesa well is to the west and about four or five miles from the San Juan River. The San Juan well is on the San Juan anticline on the right bank of the San Juan River. The Elk Ridge well is about forty-five miles north from the San Juan River.

The equipment, tools, and supplies for drilling these wells were taken to the sites by automobile and no supplies were taken by way of the rivers.

The Elk Ridge spoken of is in the LaSalle National Forest. (R. 1014–1018.) Compl. Exh. 124

is map showing location of wells near Colorado River.

He marks on map Compl. Exh. 124 with a circle denoting the position of the John L. Shafer well, the last well drilled, with respect to the Frank Shafer well. The pink color on the map indicates the outcrop of formation between Wingate sandstone and the Shafer limestone. The blue indicates outcrop of Shafer limestone and formation below it. (R. 1018–1019.)

Complainant's Exhibit 126 is identified by him as a photograph showing in the background the escarpment on the west side of the Colorado River, the foreground being in the valley at Moab and the road, part of the automobile road from Thompson to Moab. (R. 1019.)

Complaint's Exhibit 126 is identified by him as having been taken two and one-half miles below the junction of the Colorado and Green rivers at a place known as Spanish Bottom, and was taken from the Spanish Bottom side, or west side, of the river looking toward the east. (R. 1020.)

Cross examination (R. Vol. 6, pp. 1020–1021):

In the delivery of supplies and equipment for drilling purposes on the San Juan, he would follow the road of least resistance. If it were cheaper to unload from trucks on to a boat and ship a short distance and unload, he would follow that procedure, if not, he would haul the entire distance by

trucks. Whether it would be an economic proposition to split delivery in that way, switch from one system of transportation to another, would depend entirely upon the location of the well. In many cases the cheapest way of getting equipment to the site is the method followed. (R. 1020–1021.)

Further examination (R. Vol. 6, pp. 1021–1026):

The survey made by him in the country west of the Green River extended back a distance of fifty miles from the river. The lands lie in three main benches or levels. In his opinion, these lands are not and never will be, susceptible to irrigation even though a dam site could be found that would raise the water sufficiently to put it on the lands and sufficient water were available.

The lands are accessible from the river only by trails through the various canyons that run down to the Green River but are susceptible of being made accessible.

There has never been any oil in commercial quantities produced from the wells drilled in that territory. The Frank Shafer No. 1 well produced enough oil to furnish fuel for drilling purposes but none was ever shipped out. If oil had been encountered in commercial quantities a barrel or two may have been shipped out by way of the river for the purpose of analyzing it for the balance; if production were continuous it would be taken out by pipe line.

There had been a pipe line survey made for the purpose of shipping out oil in commercial quantities. This pipe line was surveyed from what is known as the Big Bend northward toward Thompson.

In the wells west of the Green River, showings of oil were found but no oil in commercial quantities, and all drilling operations in the vicinity have been discontinued. There are still great hopes that oil in commercial quantities will be encountered in the geological structures of this field.

The survey made by him took in the territory west of the last known survey corner in the Moab Valley, as the location of the junction of the Green and Colorado rivers was wanted with respect to surveyed lands. Geological conditions favorable, in his opinion, for oil production were encountered during the survey.

He has made no surveys on the San Juan River.

The survey extended south along the Colorado River only two and one-half miles toward Cataract Canyon or to the head of Cataract Canyon.

Other than heretofore testified, he has not made any surveys on either side of the Green River for the purpose of locating oil structures. (R. 1021–1026.)

Redirect examination (R. Vol. 6, 1026–1030):

A barrel of oil, in his opinion, would weigh between three and four hundred pounds, and in 1929 its value would depend upon the field from which

it was produced; 1929 value ranged from seventy-five cents or one dollar a barrel to two dollars a barrel.

Complainant's Exhibit Numbers 127–144 are identified by him as photographs typical of the country west of Greenriver. Compl Exhibits Nos. 127–144 inclusive received in evidence. (R. vol. 6, pp. 1027–1029.)

When he says general character of the country, he means the character of the country from this point midway between Greenriver and the mouth of the Green River downward as far as he went and westward as far as he went; westward to the Dirty Devil River, southward to the junction of the Dirty Devil and the Colorado, northwest to the flanks of San Rafael swell, and east to the Green River and Cataract Canyon, and part way across Cataract Canyon. Coming into Cataract Canyon from the west, some of the pictures were taken from the escarpment up above, looking down into Cataract Canyon. (R. 1029–1030.)

Recross-examination (R. Vol. 6, pp. 1030–1031):

Complainant's Exhibit Number 138 identified by him as having been taken about two and one-half miles below the confluence of the Green and the Colorado Rivers looking toward the confluence. The picture was taken at about the head of Cataract Canyon.

Redirect examination (R. Vol. 6, pp. 1032–1037):

While on the Colorado River his survey party operated two small boats for the purpose of crossing back and forth. They were row boats, one of them being roughly fifteen feet long, four feet wide, and would draw loaded, in his opinion, about twelve inches of water. The other boat he did not use and was not familiar with its dimensions.

He crossed the river four or five times at a point between Kane Creek anticline and the Shafer anticline just below what was called Sorghum Camp. During these crossings he had occasion to observe the conditions of the river bed. (R. 1032–1033.)

They had considerable trouble during some of the crossings; had to carry a survey line across the river at one location, and sent John Shafer over with the rod and the boat; he was alone in the boat; he tied the boat on the bank of the river and went up to the mesa where he was going to give them the turning point. (R. 1033.)

While he (Shafer) was going up toward the turning point they heard splashing noises along the river, and they saw the bank was caving, the river was cutting into the banks, and it would cave off big chunks of sand into the river, and they also noticed that it was caving right where this man had tied his boat.

The place looked all right when he tied it there; willows were growing there; but a big chunk of sand caved into the boat and partly sank the boat.

They tried to holler to Shafer, but he was out of reach of sound, and they tried to run around where they were standing—they were about one hundred feet above the river—to attract his attention, but they couldn't get his attention, so the thing they could do was to let him hold up the survey rod and shoot him in and wave him down so he could return to the river.

In the meantime, more sand had caved into the river, and one of the oars had floated down the river; the oars were laying on the seats, and they were moving back and forth with the current of the water, and they were afraid they would lose both oars.

John Shafer finally noticed they were trying to communicate something to him, and he started on a dead run for the river. When he got there, the boat was quite entirely under water—just the front end of the boat sticking up.

He just grabbed one oar, then he worked three hours to turn the boat over; he finally managed to turn the boat over and get the sand out of the boat.

The boat was damaged on one side; he baled it out, and then came across the river with one oar. It was a rather ticklish proposition, because he had to kind of push the boat upstream far enough so he could land on the other side above a cliff on the river; if he had landed below the cliff he wouldn't have had a landing place, and he didn't know where he would be able to get out of the canyon. A change in the current of the river caused the sand

to cave off. (R. 1033–34.) It was caving all along, as far as he could see. The river seemed to be coming up; it was a straight part of the river there. (R. 1034–1035.)

He made one trip from Moab to the Shafer No. 1 well on the large power boat of the Moab Garage. They have a man on each side—this trip they went down—they had a man in the front of the boat on each side with an oar, and these men would stick the oar into the water to bottom, and they would hold their hand where the top of the water was; then they would raise it over their shoulder, so that man at the wheel could see the depth of the water as they were going along; the man on the left side of the boat would do it, and the man on the right side would do it, and by this sounding they would guide the boat downstream. (R. 1035.)

They got stuck on a sand bar going down. Got boat off in this way: They had a couple of little windlasses on each side of the boat; they had a row-boat along, and would go ashore, tie a rope either to a tree or a rock, and then windlass themselves off the sand bar. They did this once. It is a little ratchet windlass, little hand windlass. He came back up on boat. Had trouble with sand bars once; there, however, they reversed the engine, because the sand bars facing downstream are steep, just the front end of the boat which catches; it is not as difficult to get off the bar. It is not as difficult to get off a sand bar coming up the river as going down the

river. Not easier to navigate up the river so far as sand bars are concerned.

The sand bar going downstream, the water very gradually gets shallower, then the sand rolls over and the water all of a sudden becomes deep; therefore when the boat strikes the bar going upstream, the end part of the boat is in deep water and the paddle wheel can work in deep water, and pull off. (R. 1035–1037.)

Further examination (R. Vol. 6, p. 1037):

If you got more water at lower end of bar you wouldn't stick so hard. (R. 1037.)

Recross-examination (R. Vol. 6, pp. 1038–1040):

The trip taken down the Colorado River from Moab to Shafer No. 1 well by him was made either in January or February of 1926. The boat left Moab during the morning and arrived at the oil well some time during the afternoon and consumed between four and six hours, but in going back up to Moab in the same boat it took practically all day —about eight or nine hours. He doesn't have any distinct recollection of the time he left the well or the time he arrived at Moab.

In going down the river they were hung up about twenty miles on the sand bar, which required the use of the windlass or capstan to dislodge the boat. There were at least ten people besides the crew on the boat at that time but he had no way of determining the amount of freight carried. (R. 1038–1040.)

JOHN GALLOWAY

For Complainant

(Record Vol. 6, pp. 1040–1123)

Resides 1984 View Street, Salt Lake City, Utah; age, 49 years. Has boated the Green River from almost its starting point to its mouth, and the Grand (Colorado) from Westwater Canyon to Moab; from the junction of Green and Grand to Moab; the Colorado from mouth of the Green to Lees Ferry. Boated on other rivers. First river trip as a boy 13 with his father, Nate Galloway, designer of Galloway type of boats. (R. 1040–1042.)

First trip from Westwater Canyon to Moab on the Colorado, was made in Spring of 1926 or 1927, middle of April to 12th of May. Boat as near Galloway type as possible, 16 ft. long, 4 ft. wide at top, 36 in. at bottom, draft 4 in. loaded. (R. 1043–1042.) Hard granite formation (in Westwater Canyon); tremendous fall, rapids have 2 to 4 ft. fall, straight drops; continual mass of rapids; back suction under falls makes difficult and dangerous proposition; some places steep smooth walls, could not line boats. No room to make a bed so made bed in crevices of rocks.

Below Westwater Canyon the river is sluggish and slow; shallow over little riffles, had to row or wade back in places and pull boat back, to find channel. (R. 1043–1045.) Never attempted to take boat up Colorado from Moab to Westwater; thinks he could by towing.

Has been upstream on Colorado between mouth of Green and Moab; down Green River to the mouth.

Took trip in February or March 1925, from mouth of Green River to Moab; same boat as Westwater Canyon trip. Rise in water made progress difficult; it took five days to go from junction to Shafer No. 1 well; from there went to Moab on Moab Garage big boat. (R. 1045–1049.) Rowed in places; towed in places; good many cases on sand bars; water shallow so far out boat would not tow, would have to drag on bottom; wade fifty or sixty feet to get line enough to get boat in current. (R. 1049.)

Two miles above junction place where good many rocks lying on bank and in river, narrow current. Rowed around it, threw towline around a ledge where could not pull with oars; shoved boat with oar, heaved and pulled above the rock. (R. 1050.) Towed two-thirds the way between junction of Green and Colorado Rivers and Well No. 1. (R. 1051.)

Loaded rowboat on Moab Garage boat; trip from well to Moab consumed five or six hours. (R. 1051.) Boat stuck on a sand bar within sight of Moab; reversed engine and backed up and went ahead.

A second trip was made in December 1927, up Colorado from mouth of Green to Moab; unable to take boats all the way, left them at Lockhart camp; no permanent channel to row in; water cool, trouble with floating ice. (R. 1053-54.) Walked across

the trail to Shafer No. 1 well, took Moab Garage boat to Moab. Delayed by sand bars for short intervals on trip.

In February, 1928, got his boats and trapped upstream from Lockhart to Moab; sand bars about the same—interchangeable; shifting current, change in 24 hours good many cases; try to keep in channel, but find you have to go back one hundred feet until you find a point, then go around and find channel; sand bars not in the same place every day; condition of rising and lowering of water changes the current on most any sandy formation. (R. 1056.) Finished trapping, left boat at Lockhart, took Moab Garage boat back to Moab, leaving sometime latter part of March. (R. 1056.) Boat stuck on sand bars many times for several minutes at a time.

Made three trips from Greenriver down to junction with the Colorado, but no trips up Green River.

First trip on Green River was in 1911; second, Spring of 1926, third, Fall of 1927; river conditions not the same. (R. 1057–1058.) In 1927, going down noted the river had moved; noted in particular as to camping places; would have to unload boat way back on a sand bar and carry stuff three or four hundred feet to get to where wanted to camp. Noted current was not in place where it was when there before. Noted beaver dams, were on dry land; beavers selected deep water for winter food supply. (R. 1058–1059.)

Green and Colorado Rivers do not freeze except in places where river is shaded by ledges. (R. 1059–1061.)

Material for building boats, and supplies hauled overland from Greenriver to North Wash. Country is desert in character. Saw one ranch on San Rafael, but no settlements. First trip in 1911 from Green River, Wyoming to Dirty Devil. Returned with pack outfit, leaving boat at mouth of Dirty Devil. (R. 1062–1064.) Did not see any one boating on this trip. (R. 1065–1066.)

Has not seen boats on Green River carrying freight or passengers. (R. 1066.)

Trip from Green River, Wyoming, to Dirty Devil made in September; trip from Greenriver to North Wash, where boat was built, in March or April of 1927. Third trip from Greenriver to Glen Canyon by river made in 1924. Went out from Lees Ferry to Kanab overland. (R. 1066–1068.)

Same difficulties from end of cataracts to Lees Ferry on Colorado, only difference, more water; river wider, boxed in places. Where river crowds against ledge, there is a great big whirlpool. (R. 1068–1069.)

Only boats he saw were some tied along river; did not see any ranches from mouth of San Rafael to Lees Ferry; no fertile or plowed lands. One old prospector, named Carpenter, below cataracts. Hite ranch deserted. (R. 1069–1070.)

In his opinion, impossible take a boat from Greenriver to Colorado line; 120 rapids in Desola-

tion Canyon; 30 rapids in Spit Mountain Canyon. (R. 1071–1072.)

Has never taken boat from mouth of Green to Greenriver, supposes he could take a boat from mouth of Green up to Greenriver by rowing and towing; same as on Colorado, only distance farther.

Cross-examination (R. Vol. pp. 1074–1110):

His father was Nathaniel Galloway, did considerable trapping on Green and Colorado Rivers; boated down the rivers and designed type of boat known as Galloway; never used motor boats. (R. 1074.)

Impediments, bars, between Shafer well and Moab not substantially the same or worse than on lower stretches of Green. Places on Green, forty or fifty miles up, nothing like on the Grand (Colorado); more riffles, swifter water. (R. 1077–1080.)

More water in Green. (R. 1080.) Going up Colorado River is hard work.

If he had a permit to trap beaver between Moab and the junction of the river, and was coming back and could get to Moab, why should he not want his boat to be at Moab. Then he could float down the river. (R. 1084.) He was in floating ice when he left that boat at Camp Lockhart; he had a hard time getting from the junction of the river to Camp Lockhart; he didn't care to go any further.

If he had wanted to go any further, he wouldn't have walked over the hill and carried his stuff out of there in order to get that big boat. (R. 1085.)

The beavers select, as he understands them, for putting in a cache for their winter food, any deep water; he wouldn't necessarily say that it is the channel of the river, but most usually where you find the channel of the river you find the deep water.

He has trapped enough beaver to know wherever to find the home and cache of beaver and you find it in deep water. He naturally assumes the deep water is where the main channel of the stream is, any place on that river. (R. 1086–1087.)

On his first trip down the river in 1911 he spent about four months between Green River, Wyoming, and North Wash, which is about four miles below the Dirty Devil River. The trip was made for the purpose of prospecting for placer and quartz and was made all the way between those two points in a boat.

On the second trip which was made in 1924 from Greenriver, Utah, to Lees Ferry, he was accompanied by his brother and all of the supplies taken were purchased at Greenriver, Utah.

On a trip made in the winter of 1925, he entered the Green River at Ninemile, Utah, about twenty-four miles below Ouray, Utah, and boated down the Green River to the junction and up to Moab.

The trip made in 1926 commenced at Ouray, Utah, and ended at Lockhart (below Moab on the Colorado River). He was accompanied on the trip by a man named Dave Fraughten.

All of these trips were made for the purpose of trapping beavers for the State of Utah. (R. 1087–1092.)

There was no bounty on beavers, but he would go to the Fish and Game Commissioner and get a permit to trap a portion of the river and because beavers are protected in the State of Utah it is necessary to get a special permit to trap them.

These permits are issued when beavers are sufficiently numerous and there is no danger of extinguishing them and they divided half of the beaver skins with the State when the expedition was finished. (R. 1092–1094.)

The next trip that he referred to started at Ouray, Utah, and ended at Lockhart. The next trip on the river was when his brother and himself were trapping for the State of Utah from the Utah-Colorado line down to Moab and these trips were for personal profit under arrangement with the State. (R. 1094–1095.)

The trip he made when he hauled material from Greenriver, Utah, to the mouth of North Wash and built boats was made for the purpose of prospecting for placer ground. He was accompanied by his brother, and a man named Howland, who wanted to look at the river for the purpose of putting sightseeing boats from Lees Ferry up. This trip was made in 1927 and he is positive that both his brother and Mr. Howland made the trip with him.

His brother also accompanied him on the trip made in 1924. (R. 1092–1100.)

Mr. Howland's purpose in going on the river with him (Galloway), was specifically for inspecting the river to see if it could be used for purposes of navigation with a steam boat. He and his brother had conversed some with Howland concerning the conditions of the river between North Wash and Lees Ferry prior to the trip. (R. 1097–1101.) Mr. Howland abandoned the project after going through Glen Canyon. (R. 1112–1115.)

The last rapid in Cataract Canyon from North Wash is probably ten or twelve miles. There is more swift water between the mouth of North Wash and Lees Ferry than there is on the Green above its confluence with the Colorado. There are some rapids in Glen Canyon. (R. 1102–1103.)

On those riffles; there is something he has never been able to understand; he has encountered difficulties just the same there as he has above, where there is less water on shallow places.

He finds in boating that river the conditions are where you find them; that is all he can say; you run into it where you least expect it.

The conditions of the formation around the river is what gives you the width of your river. Now, there are places down there where there is more water; it is possibly quite a lot wider. Other places you will find it pretty much boxed in, ledges come in. Whether it be wider there than it is above, he does not know; he had no way of measuring it.

Down in Glen Canyon there is more twisting water; there is a larger volume of water, of course, and there are places where it has whirls, undercurrents and that, more so than there is on the Grand (Colorado) River. (R. 1105.)

He has never been from Moab downstream to the junction of the Green and the Grand (Colorado) Rivers; for that reason he would say he had more difficulty going up the Grand (Colorado) River to Moab than he did going down through Glen Canyon, because in one place he was pulling upstream and in the other he was drifting. (R. 1106–1107.)

Did not have any more difficulty in going from the mouth of the Dirty Devil down to Lees Ferry than he had in going from the mouth of the San Rafael down to the mouth of the Green River. He means by that, there is no part of the river that a man, if he can boat it at all, and will use the proper precaution, that he will not run into the difficulties that exist there if he doesn't watch out what he is doing.

There are plenty parts of the river where, if he is careful, and knows his business, he will not be able to surmount the difficulty. (R. 1107.)

Besides having boated the Green and Colorado Rivers, he has had some experience on the Snake River. He has had experience in boating on the Snake River from All Pine to Idaho Falls, a distance of about eighty miles by the river. All Pine, or Blue Pine, is on the south fork of the Snake River. He believes that it is less than one hundred

miles from where the Snake River heads. The north fork joins the south fork above Idaho Falls, he believes fourteen or sixteen miles. He is not familiar with Shoshone or Twin Falls on the Snake River. The part he is speaking about is not far from Rigby, Idaho. He does know Twin Falls a little and a man could not go over them in a boat. (R. 1108–1110.)

Redirect examination. (R. 1111–1115):

By quiet water he means it would be a strip of river where it is boxed on one side either by a ledge or a permanent bank, and below it a riffle or a rapid, and they may be a half mile—one hundred yards or something—quiet water before it breaks over this final pitch. (R. 1111.)

Through Labyrinth Canyon and Stillwater Canyon considerable trouble with sand bars was encountered and also quite a lot of swift water. Stillwater Canyon is more confined within ledges; there are open spaces with sand bars. There are some riffles but not as bad as they are higher up; they become more calm down farther in the canyon and the water is very shallow in places where it is wide.

He has been through Cataract Canyon twice but did not run the rapids. In his opinion, there were forty rapids in Cataract Canyon but he doesn't know the exact number. (R. 1111–1112.)

He lined boat through. (R. 1112.) In some places had to pull it over rocks; you can't push it out and make it go through without having danger

of getting it wrecked into the rocks somewhere, and losing it, and in that case you would have to drag it over the best you could until you could get it where you could start it again, and go on. (R. 1112–1113.)

On the trip when he was accompanied by Mr. Howland, Mr. Howland abandoned the project after going through Glen Canyon.

When his father was trapping on the rivers he sold furs some place in the east, Vernal, Utah, and Greenriver, Utah, being shipping points.

Jensen, on the Green River, is a town of possibly five or six hundred people. Supplies to Jensen are brought in overland with team either from Mack, Colorado, or from Price, Utah. They are not brought in by way of the river.

Ouray, on the Green River, is a town of probably two hundred fifty people, counting Indians. Supplies to Ouray are brought in overland and not by way of the river. There is a ferryboat at Ouray used for the purpose of crossing the river back and forth. The Ute Indians who live at Ouray, use the ferry for crossing back and forth but so far as he knows, they do not use boats of their own in any way on the river. (R. 1112–1115.)

Recross-examination (R. 1116):

He is acquainted with the fact that there is a tribe of Indians in Idaho known as the Blackfoot but has never known of them to use boats on the Snake River and does not know whether or not they are more civilized than the Indians in Utah.

By quiet water he means still water that is just above large riffles. (R. 1116.)

Further examination (R. 1117–1119):

Hanksville, Utah, is a settlement of about three or four hundred people who engage principally in the sheep business.

He came down through Cataract Canyon twice. The first time he went down there he was alone.

The supplies would not exceed five hundred pounds, camp and all.

And the second time he went down with his brother. And with a little more supplies. They always go in places like that as light as they possibly can.

When he went down Cataract Canyon first time had only knowledge from what his father said in regard to the condition of the canyon. He had no maps or charts or surveys. (R. 1118–1119.)

Redirect examination (R. Vol. 6, pp. 1119–1121):

In going through Cataract Canyon he made portages. He carried the duffel in Cataract Canyon pretty near from one end of it to the other. (R. 1119.) Just at intervals of rapids he would tie up, and take most of his equipment below the rapid; then either run the rapid or line it, whichever he thought he could do the easiest. (R. 1119–1120.) The rapids were lined by himself alone and if he came to one he thought it safest to line, he would do so. (R. 1129.)

In going through these rapids a map is of no assistance at all, as he can see. The only thing a map might tell you, was what the rapid is, the name of it, or where it was located. He was looking at one of the maps and he couldn't see that would help him any in going through that canyon.

When he comes to a rapid his procedure is: The first thing is to stop before he gets too close, so he can stop; in the still part of the water above the rapid there is always a still space of water; stop and go down and look the rapid over, see if there is a possible channel or way a man can navigate a boat through it without hitting a rock or striking waves so high that there is danger of putting you underneath, filling your boat with water, or something like that.

You know about what your load is; you know about what your boat is carrying, and about what kind of waves you can battle with. If there is any possible way you can see that it looks like it is safe enough for a man that is in there alone, or two parties—that he can get through without losing his outfit—you would naturally get in your boat and go and pick down through where you had sized it up and looked it over and thought you could make it, as near as you could possibly.

In running rapids, every rapid you run, you run the rapid only after a personal examination. (R. 1120-1121.)

Further examination (R. Vol. 6, pp. 1122):

He doesn't know of his own personal knowledge whether or not rapids are run on the rivers in the west as they are in the east, by guides and Indians poling the rapids, one man at each end of the boat.

Recross-examination (R. Vol. 6, pp. 1122–1123):

When he lived in Vernal he didn't know whether there were other trappers than his father who lived there. He would judge there were probably six hundred people in the whole Vernal Valley.

He left Vernal when he was about seventeen years old and his father died at Richfield, Utah, after he had left. (R. 1123.)

PARLEY GALLOWAY

For Complainant

(Record vol. 6, pp. 1123-1154)

He is a farmer, stock raiser, and trapper, is forty years of age. He has had experience boating on the Green and Colorado rivers and has run the Green River from as far up in Wyoming as it is possible to boat, and the Colorado River to Needles, California. He has also boated on the White River, the Bear River, and the Yampa River. He has made four or five trips through Flaming Gorge, Red Canyon, and Desolation Canyon on the Green River and has been on the river in those sections at other times.

It would be possible, in his opinion, to take a boat up the Green River from the City of Greenriver, Utah, to the dam, about eight miles above the town.

He has never seen any other boats than his own in operation on the section of Green River north of the town of Greenriver, Utah.

He has made four or five trips down the Green River to its junction with the Colorado from Greenriver, Utah. In that section of the river he always found the location of the sand bars to be the same but had a good deal of trouble with them. This trouble occurs nearly all the way along that stretch of the river. There were some stretches of the river where he didn't have quite as much trouble, but others were bad enough to pay for it. (R. 1123-1126.)

He has been through Cataract Canyon twice. One of the trips especially remembered by him was with the Eddy party in 1927, when he acted as guide for the party and operated the boats as head boatman. Considerable trouble was had on the first part of the trip because none of the party except himself had had any experience in navigation. The first rapids they came to were run. (R. 1126-1128.) Ran them with all their loads in the boats. These boats were well decked boats that Mr. Eddy had, so they could run in waves where they were pretty big. They were there in high water, so didn't have so many rocks to contend with as he would in lower water. At about the fifth rapid in the cataracts is where had their most trouble. Had to unload everything and line boats around the fifth rapid.

From there on ran the rapids until got to the last rapid in the cataracts, that is Dark Canyon rapids;

lined that one. Always unloaded some of their duffel, not all of it every time, but nearly all the heaviest part of equipment. (R. 1128.)

Prior to the Eddy trip he (Galloway) had been through Cataract Canyon with his father when he was a boy but does not remember the month or year when the trip was made. He has been through Glen Canyon three times. (R. 1128–1129.)

Did not have a great deal of difficulty in taking the Eddy party through Glen Canyon; found sand bars, but had real high water, and the sand bars were more covered up. Stuck on the sand bars though. Nearly every day would hang on a sand bar, some of the boats would hang on a sand bar. (R. 1229.)

The other trip he took through Glen Canyon was when he left North Wash with his brother and Mr. Howland and difficulty with sand bars and riffles was encountered during that trip.

On his trips between Greenriver, Utah, and the mouth of the Green River, he did not see any other boats empty or carrying freight or passengers.

There have been some ranches in that section of the country but everything is abandoned now. From the mouth of the Green River down to Lees Ferry there is one old abandoned ranch that has been abandoned for some time, in as much as the cabins have fallen down. He remembers a place called Hite but there was nobody living there.

He met no other boats either light or carrying freight or passengers during the times he was in

Glen Canyon and from there on down to Lees Ferry.

The trip he made with his brother and Howland from North Wash was made late in March, 1928, and the Eddy trip was made in June, 1927.

The Howland trip started from the mouth of North Wash with two boats loaded with camp-outfits and supplies, the load amounting to five or six hundred pounds to each boat. The lumber and supplies were purchased at Greenriver, Utah. (R. 1129–1132.)

Didn't build boats in Greenriver, Utah, and go on down the river, because wished to avoid the Cataract Canyon. Could make the trip quicker by going overland. (R. 1132.)

From the mouth of North Wash down to Lees Ferry there are a great number of riffles, some of which would be considered rapids, were encountered.

He never tried to bring a boat from Lees Ferry, up the river. (R. 1132–1133.)

He has boated on the Colorado from Westwater Canyon, near the Utah State line, as far as Moab, four or five times, but has never boated down the Colorado from Moab to its confluence with the Green. All of his trips on that section were made up the river.

Many difficulties were encountered on his trip through Westwater Canyon, the rapids there being as bad as they are any place in the Grand Canyon. Sand bars and gravel bars were also encountered on this trip.

It is his opinion that boats could not be taken up the Colorado River from Moab to Westwater, but that they might be taken up a distance of about fifteen miles, although it would be necessary to do considerable towing in that distance. It would be impossible, in his opinion, to row a boat that far up the river.

He has never seen any boats on the Colorado River between Westwater and Moab.

He has been up the Colorado River between its confluence with the Green and Moab three or four times. (R. 1132–1134.)

The difficulties encountered in going up that stream are always bad enough with a row boat; some of it you row, some of it you tow your boat the best you can. Had the sand bars; running behind a sand bar, sometimes would have to turn and go back, hunt around and find some little channel that you could get your boat up through. (R. 1134–1135.)

One trip made on the Colorado River between the mouth of the Green River and Moab, was in March of 1926, when he was accompanied by his brother. Very little equipment was carried on the trip and it consisted principally of camp equipment and a very little grub.

In places where a sand bar or bank was found that could be walked along, the boat was towed, one man walking along the bank with a sixty foot rope tied to the boat, the other man using the oars to hold the boat in the river.

From some place above what he believes to be oil well No. 2, they took the Moab Garage boat into Moab. The Moab Garage boat hit sand bars in a place or two but was always able to back up again and then go ahead, making the trip without losing a great deal of time.

He made another trip on that section of the river with his father a good many years ago but does not remember the date. He has also made two or three other trips, one being made in 1927 with a young fellow by the name of Zerber.

This last trip was from the mouth of the Green River to Moab. The boat was not taken all the way to Moab but only as far as well No. 2, where it was loaded on the big boat and taken on up. The same difficulties were encountered on this trip as were encountered on the other trip. After reaching Moab the boats were taken to Greenriver, Utah, by truck. (R. 1135–1137.)

Didn't go on down the Colorado River and then up the Green to Greenriver, because of the hard labor of getting up there is something fierce; wouldn't want to undertake it with a pair of oars. (R. 1138.)

He can not tell how long it would take to make the trip from Moab to Greenriver City by boat but in his best judgment it would take about a month's time. By truck it takes not over eight hours' time.

He has never been over that section of the country by boat between Moab and Greenriver. He has been from Greenriver to Moab, of course, by boat.

Between Moab and Greenriver there is a ranch house somewhere on the road but he doesn't remember just where it is.

The land in the surrounding country is mostly bad land, cut considerably with deep washes. The land does not look like farm land to him. (R. 1138–1139.)

Cross-examination (Record vol. 6, pp. 1139–1152):

There are two years' difference between his age and that of his brother, John Galloway. He is forty years old and his brother 42.

When he took the trip with his father through Cataract Canyon he was 15 or 16 years old. No one else accompanied them on the trip. As he remembers, some of the rapids on the trip were lined, but he has no distinct recollection of it.

The trip ended at Lees Ferry. From Lees Ferry they went back to Kanab and from there they went to Uintah County, Utah.

The purpose of the trip was for trapping and prospecting; prospecting being down in Cataract Canyon. (R. 1139–1141.)

On the Green River in Wyoming he has boated up from the mouth of the Fontanelle and doesn't know whether a boat could be run any further than that. The water was real shallow in lots of places on the stretch of the river he boated up.

By boating water he means sufficient water to carry a boat, man, and provisions. (R. 1141–1142.)

As you get down into the vicinity of Greenriver, Utah, the boating conditions do not get better; have more sand bars down further. (R. 1142–1143.)

From Greenriver through Labyrinth to Stillwater Canyons there aren't the dangers of rough water that occur in Westwater Canyon on the Colorado. In travelling upstream with a rowboat frequently it is much easier to get out and tow the boat than it is to row. (R. 1143.)

He has always avoided going up stream as much as possible with a rowboat. (R. 1143.)

When rowing upstream he attempted to keep in the quiet water as much as possible and to keep away from the swift current and in doing that he boated in the shallower portions of the river. (R. 1143–1144.)

Some of these bars cross clean across the river; it is very hard to find a channel through, anywhere. (R. 1144.)

But when rowing up stream, and seeking the quieter water, over where it is more shallow, boat much more frequently touches ground of necessity. (R. 1145–1145.)

On the Eddy expedition no one besides himself had had previous experience with boats, or with the river and therefore encountered quite a bit more trouble than would otherwise have been encountered.

As a boy, he made many trips with his father, but only the one trip spoken of on the Green and Colorado Rivers to Lees Ferry.

On the trip with his brother and Howland from North Wash down to Lees Ferry, he did not survey the river to determine the general depth of the channel. (R. 1145–1146.) Parts of the river, in places, you might find what would be three or four feet of water for a distance of probably a quarter of a mile, and then the river spreads out in sand bars and gets shallow. (R. 1147.)

In boating that stretch of the river it was necessary to hunt for the channel. He had not been over that part of the river recently. (R. 1147–1148.)

And there was sometimes difficulty in determining just where the channel was; the bars would head you off a good deal, and you would have difficulty finding deep enough water to float through over the sand bars. (R. 1148.)

When sand bars were struck the boat would be backed up and deeper water found if possible.

Except when he was a boy and he was with his father, when a rowboat was used, his only experience on the Colorado River between Moab and Shafer No. 1 well has been on the large Moab Garage boat.

He doesn't remember the frequency with which sand bars were encountered on the trip with his father. (R. 1148.)

A contract was made by him to take Mr. Howland over the Colorado River from North Wash down to Lees Ferry. He was paid the agreed compensation and the boats used were built for that purpose.

He has never operated a power boat on the rivers.

The reason boats were built at the mouth of North Wash when the trip was made with Mr. Howland, was because Mr. Howland did not specifically desire to go through Cataract Canyon. (R. 1149.)

As near as he can remember, the trip from North Wash down to Lees Ferry consumed about three weeks. On the trip down, some prospecting was done and some exploration of the river was made. They did not stake out any claims.

There was a man by the name of Richmond who went with his father the first trip that he made through the Grand Canyon and he started about Flaming Gorge and went clear through to the Grand Canyon of the Colorado. He was just a boy and he remembers the man Richmond. He doesn't just know how old he is, or whether he is dead or not, but his father is dead. He remembers of the two of them being at their home in Vernal but he didn't see the boat arrive or depart. (R. 1150–1152.)

Redirect examination (R. Vol. 6, pp. 1152–1154):

On the trip back to Vernal, Utah, from Lees Ferry, after his trip on the river with his father, they went by stage and train.

The trip made with the Eddy party ended at Needles, California, and he returned home by way of Salt Lake City.

In speaking of operating a boat wherever he found boating water, he means an ordinary row-

boat about sixteen feet long, five feet wide at the top, three feet wide at the bottom, and would draw about four inches of water loaded with camp outfit and men. (R. 1154.)

VIRGIL BALDWIN

For Complainant

(Record vol. 6, pp. 1155-1215)

He resides at Moab, Utah, automobile mechanic and boat pilot, 41 years of age, lived most of his life on farms in Ohio and Indiana. In May, 1921, he moved to Moab, Utah, and commenced working for the Moab Garage Company as mechanic. In 1925 he commenced operating a boat on the Colorado River and since that time he has operated on the Colorado River about three small boats and one large boat.

One of the boats operated by Baldwin was twenty-seven feet long, about five feet wide, drew about ten inches of water with an ordinary load, and was powered with a six cylinder automobile engine, fifteen-fifteen propellor. This was called the passenger boat and was for light work. It was equipped with removable seats.

The other boat was powered with a Ford motor and was about twenty feet long, probably four feet wide, and drew possibly six or eight inches of water; with the propellor it would be a little deeper. The propellor used was a fourteen inch one with a guard underneath, making about sixteen inches altogether.

Another boat was known as the Black boat and another the Evinrude boat, which was about eighteen feet long, probably three and one half or four feet wide, round bottom, and drew ten inches of water. The Evinrude motor was hinged on the boat so that it could be set at an angle with the boat or straight down. If the propeller struck an obstacle the pin would break the motor being rigidly set.

The passenger boat had a gear shift but only high and reverse were used. (R 1155-1157)

I could not use that gear shift to plow through the sand; just left it in high gear all the time because got better results. (R 1158)

The big boat was about seventy five feet long, fourteen or fifteen feet wide, constructed of heavy material, the sides being three inch plank and the bottom double planked and caulked with oakum. It was built very heavy so as to withstand the rocks. At first it had a square end front, afterward a pointed bow was put on, this being necessary in order to part the water better. It was first equipped with an automobile engine and then with a Walkenhaw motor and a new paddle wheel.

The Evinrude boat was a keel boat but the others were all flat bottomed.

The large flat bottomed boat was built in February 1925. (R 1158-1159)

He helped build the paddle wheel and installed the motor on the big boat. The wheel was eight feet high, twelve feet across, and had twelve pad-

ches. The boat drew about eighteen inches of water light; when loaded it would probably draw twenty-one inches. The paddles on the wheel were constructed of twelve-inch boards and the boat was loaded toward the front so that the wheel would not extend more than eighteen inches beneath the water. (R. 1158-1160.)

The wheel beams, you might call them, extend over the back of the boat a distance of half way of the wheel, or a little more, so as to have some clearance between the wheel and the boat; consequently while the boat is empty the beam projected over the back; it would be a little lower if the front end of the boat is loaded heavily; it brings the front end down and the back end up a little, that is, out at the center of the wheel; consequently you don't change the position of the paddle wheels very much, maybe two or three inches or three or four inches at the outside, probably, in depth. (R. 1160.)

The paddles on the wheel did not extend quite as far down as the bottom of the boat.

Until February, 1925, he had never had any experience in operating boats on the Colorado River except a trip or two with the Evinrude boat when he went down the river on a pleasure trip or hunting deer, but didn't have much pleasure (R. 1161), because of the difficulty in getting any place while on the boat. Would get stuck on a bar. If the propeller would happen to hit a rock or anything, it would shear a little pin off—fixed to shear off, so it wouldn't tear up the motor. This Evinrude motor

was equipped with a water pump to keep it cool, plunger pump, it wouldn't work because the sand in the river would get around this pump and clog it up.

As to cooling system on the big boat, they finally discovered a way to submerge some pipes on the outside of the boat so the water from the river would keep these pipes cool, circulate the water on the inside of the pipes through the motor, cool the motor, and back through these pipes again; they found that the most successful way of cooling.

Used the river water for that purpose, dip it up and let it settle, then put it in the motor, so the sand wouldn't cut the pump out, used the same water over and over again.

First tried pumping it out of the river, but it wasn't satisfactory because of the mud and stuff in the river, the sand.

After the big boat was launched, his brother, Clarence Baldwin, had charge of the operation of the boat. He operated the big boat the first trip. Witness had made a few trips down the river before that, so they let him go ahead with the small Evinrude boat, to help locate the deepest water. That is the way they got by without quite so much trouble.

The first trip got stuck and didn't even have any anchor with them; in case they broke a chain or anything to hold their boat from drifting away from where they wanted it to go; didn't have any steel cable with them; had some inch Manila line.

rope line; undertook to take that to shore; it just carried the rope downstream; had quite a job getting to the bank; he fell in clear up to his neck. Was stuck there with boat for about three hours before got off. (R. 1161-1162.)

On this trip it was necessary to take lines to shore in order to pull the boat into deeper water.

About ten hours' time were consumed in making this trip from Moab to Shafer No. 1 well, which is a distance of between nineteen and twenty miles.

After the first trip he took charge and piloted the big boat. He would estimate that he made probably eighty or ninety trips on the river in 1925 and about the same number in 1926, making a total of between two hundred and fifty and two hundred and sixty trips all told. In 1928 probably twenty-five or thirty trips were made, the balance being divided between the years 1927 and 1928.

When boating first started in March, 1925, trips were made steadily to the Shafer No. 1 well for probably five months, hauling material. Trips were made in the fall of the year now and then. Trips were made the following year during nearly every month, making a trip every few days. In 1927 and 1928 there was not much done. (R. 1163-1164.)

On the first trip, only ten tons of freight were taken; after that probably between twelve and fifteen tons were taken for a while but it was discovered that less trouble was had with less load and better time could be made. The crew consisted of

two men besides himself, who was pilot. The motor consumed about five gallons of gasoline per hour. (R. 1165.)

Had trouble with sandbars in and about the landing at Moab. After high water most always along there at the dock, have to get the boat a short distance above the dock and run the wheel and keep backing into it, to keep it to a place suitable to land and get out the load. (R. 1165.)

The dock was on the opposite side of the river from Moab, about three miles from town. From the docks to town a good road crosses the bridge and then leads to town.

Does not always find the deep water on that stretch of the Colorado between Moab and these oil wells in the same place. It changes very often. It changes probably in three or four days. The worst time, when they happened to be off the river a short time and come back on to it, they are completely lost, until you get familiar with the river, and then you have, sometimes, to find the proper place to go, and invariably they would take the wrong course.

It is a fact that every change of that river in the stream flow makes a rearrangement in the sand.

Now, when that rearrangement comes, not never easily able to tell where the deep water is by any experience that he has had before; it is all guess work. The best way he could tell would be to get out and climb on top of the cabin and look ahead

and see which way the most water is going, and say, "Well, looks like it is going here, because it is wider"; get into it, and the first thing they know, they are stuck.

If the other course, where the river has divided—probably be deeper and not so wide—when they get stuck—the back of the boat always strikes first, then swings around on them, because they are stuck, and lose control of the boat, and time and again swing the wrong way and get stuck worse. (R. 1166–1167.)

This is the big boat he is describing. So they always have a small boat along with them. Will get out in it and feel around and see which way to go; sometimes we don't go then until they take a line ashore and pull the boat the way they want to go and get into deeper water again, and probably go on all right for a good while.

Had more trouble in operation of that boat at low water, because there wasn't sufficient water in the river to float the boat properly. (R. 1167–1168.)

High water occurs during May and June of each year because of melting snow. When a raise comes in the river because of rains, navigability conditions become worse. The water comes down the river in a rush, sometimes builds a bar clear across the river which is very difficult to cross and causing delays of a day or two in boating.

In normal water more miles per hour can be made downstream with the big boat but in case a sand

bar is struck it is more difficult to get off than when boating upstream because the current keeps shoving the boat tighter against the bar. (R. 1168.)

So far as ease of navigation with this large boat is concerned, leaving out the question of speed, with reference up or down stream, ordinarily going upstream run on to a bar, can back off of it and try it again, but in numerous cases have found going upstream no places deep enough that could use the rudder properly and hold it upstream; find it very difficult to go upstream, because couldn't handle the boat; it would turn around; the back end of the boat strikes bottom, and you lose your rudder control of your boat; you can't handle it. (R. 1168–1169.)

Bars are occasionally encountered in high water because it is impossible to see where the bars are and it is natural to attempt to cut across corners in boating.

If no trouble were encountered the trip from Moab down to Shafer No. 1 well would consume from two to two and one-half hours; the return trip consuming from six to seven hours, sometimes longer.

The boat could be taken down stream in that time about twenty-five per cent of the time; the other seventy-five per cent would take longer because of trouble with sand bars. (R. 1169–1170.)

The greatest length of time ever consumed in that trip downstream was one trip to No. 2 well, as they call it, twenty-seven or twenty-eight miles

down the river; got stuck about a mile and a half below Frank Shafer well No. 1 for a day and a half; that is the longest time they were stuck. (R. 1170.)

This was in August, 1928, and the boat was stuck where the river took four different courses, none of them being deep enough to float the boat.

The complete trip was made in probably two days and a half. At other times when the boat was stuck on sand bars it ordinarily took from an hour to four hours, "very many times," to get the boat free. The longest time spent in making one trip from Shafer No. 1 well to Moab was ten hours. (R. 1171.)

With reference to Moab the bar that he spoke about that it was necessary to churn up before he could get out is located at the Moab landing, right at mile 65.

No difficulty at island mile 64. Between there and the dock generally very bad. Always had a little trouble through there at miles 65, 64.

Did not make dock further down the river because the country is all sandy on each side there; no road. Could not build road for hauling heavy material, so had it close to the public road. It would be too expensive to build. (R. 1171–1172.)

Between miles 63 and 64, Compl. Exhibit 10, from the bend to Mill Creek, the river is very wide and usually divided by visible bars between the two banks and it is difficult to tell which side to take to get through, the water being shallow all the way

across, sometimes the deepest water being on one side and sometimes on the other.

At one time a flood on Mill Creek washed mud, sand, and rocks across the river two-thirds of the way, causing trouble for a week or ten days; in boating past, the boat getting stuck at times.

From Mill Creek to Mile 59 is always a difficult place on the river and he has seen the same conditions almost at Kane Creek as he described when the flood came down Mill Creek. In that stretch of the river from Mill Creek to Kane Creek the channel crosses the river from side to side about four times, he believes. (R.1172–1173.)

From Kane Spring Wash up to mile 55, little trouble is encountered, but between miles 55 and 56 trouble is generally looked for, that being the place where the boat was stuck on the first trip. There are two to three channels there.

Between miles 53 and 54 he has had trouble because the river is divided into two channels by a big rock that sets out from the bank, and many times the main current runs straight toward the rock.

Between mile 52 and 53 the only trouble encountered was in January, 1926, with an ice jam.

Between mile 49 and 50, which is near the well, there is a sharp bend in the river with a rock in the middle which bothers at low stage of water.

Between miles 43 and 48, especially between 43 and 44, is where he was stuck on a sand bar a day and a half and there were at least three or four

channels in that place, the deep water sometimes being in one and sometimes in another.

Between miles 39 and 43, near the Shafer well No. 2, he has been stuck a number of times because of shallow water, there being not less than three channels in that place and the deep water is not in the same channel always.

Between miles 32 and 33, which is below the J. H. Shafer well, he has been stuck a number of times.

From mile 32 down to mile 37 at Lockhart Canyon, little difficulty was encountered except right at Lockhart Canyon where he had trouble with two channels.

The troubles recounted by him were encountered principally during July, August, December, and January, or during the lowest water. During the winter he was troubled with floating ice and heavy galvanized iron was put on the front of the boat to keep ice from chewing the wood.

In February and March trouble was frequently encountered in the stretches of the river pointed out on the map Compl. Exhibit 10 by him. Some trouble was also had in the month of April. (R. 1172–1178.)

In April had rains that would make these washes, wash some sand into the channel at times, remember one time, think it was in 1927, during April, thawing weather, there was a big rock fell from way up high on a cliff, imagine five hundred feet above the river, landed in the river. That later gave

them a little trouble; the channel finally shifted to that side. That was the only time he guesses.

In June and July high water is going down, you might say, and it is really the worst time then, because the bars begin to show up when the river falls; just have to feel your way along there. (R. 1179.)

In September, October, and November, the river has a more permanent channel than in very low water. Mill Creek and Castle Creek are perennial streams.

In that section of the country heavy rains usually occur in August. (R. 1179–1180.) The effect that has on these dry washes, and on the Colorado River immediately downstream from the washes is this. It washes in so much sand; at one time the Kane Wash came in with such force it seemed to wash the sand in long waves, like; was going down with the big boat; one of these waves seemed to be four feet high; the boat went through it; it seemed to bend it up and down lengthways, like it might break it in two. Between the waves, the water seemed to be only eighteen inches deep; the bottom of the boat would strike in between the waves, like, that way, for probably a quarter of a mile below this wash. As they came further, it would be quieted down, but it would be swift and shallow until they couldn't hardly make it upstream at all; held them along in places for probably a quarter of a mile, and maybe get into a little better place, and get past the wash and go on without much trouble.

In the operation of this boat he distributed the members of the crew in this way in connection with the operation of the boat. Going downstream, if they hadn't been on the river for a day or two or a week, would always have them up on front, sounding; it would help quite a bit; take an oar, one fellow on one side, show him how deep it was. (R. 1180–1181.)

If the water was the depth of the oar blade the boat could be taken through nicely; that would be about two and one-half feet of water.

If running regularly there wouldn't be enough work to keep the men busy beeause he would know very near where to go, but would often get off his course and get stuck. (R. 1181–1182.)

Discarded this Manila rope carried on the first trip; found had to get a steel line, about five hundred foot line, so could pull it through the water easier; going to shore they would always have to put the line in the small boat, coil it up in that small boat and reel it out as they go along, so the current wouldn't carry the boat downstream; first thing they knew, they wouldn't have any line, by the time they got to the bank. Sometimes go down without using that line; other times have to use it four or five times, probably. (R. 1182.)

He had a conventional form anchor on the big boat which weighed about one hundred twenty-five pounds. (R. 1182–1183.) It is very important, a fellow breaks a chain that goes back to the paddle wheel, don't want to drift on downstream very far;

throw out the anchor, and the boat will turn around, upstream; this anchor will dig in the bottom of the river, and hold the boat there until you get the repair made. Also used it a great many times, where got stuck, when they have not been in a position to get the line to the bank, to pull in the right direction they wanted to go; so take the anchor out in a small boat, throw it over, and hitch line on to that; it would help hold the boat upstream in the position they wanted to go. (R. 1181.)

At first, he thought that a map would be of some benefit to him in navigating the streams but discovered it was no use whatever, because there were so many changes in the river. One week the channel would be where shown on the map; the next it would not be there. He tried to keep the position of the channel in his head, remember where he went last, and tried to strike the same place again but very often he would miss it.

He didn't have a license to operate the boat because there are no license laws for navigation in the State of Utah and he was told one was not required. There is danger of upsetting small boats in sand waves but he doesn't know that that has ever happened, but the boats do ship water.

Sand waves usually occur during high water in May and June and during the cloudburst season in the fall of the year. He has seen sand waves last for probably a day, the next day they would be gone, water would be shallow and the sand seemed

to have flattened out on the bottom. (R. 1183–1184.)

He has never been to Lockhart from Moab overland but was down Indian Creek once to repair a truck. The main highway from Moab is a good road but the road down Indian Creek is rough. At the time he went down, material was being hauled in to the drilling locations on Indian Creek.

The country to the left of the road between Moab and Greenriver, Utah, is quite rough and contains sand and rock. So far as he knows, no one lives there. There is one place along the road between Greenriver and Moab, about halfway, where it looks as if someone had tried to farm lands. They had constructed a little reservoir to catch run-off water for irrigating purposes. He imagined there were five or six sections of pretty good land in that vicinity.

He very often used one of the smaller boats to make trips from Moab to the oil wells and back. With the twenty-seven foot boat considerable trouble was encountered in shallow places if they were loaded. (R. 1185–1187.)

On a recent trip made between Moab and the mouth of the Green River with Mr. Ryan and Colonel Dent, the usual difficulty in navigation was encountered in places because of sand bars both down and up the river.

He also remembers a trip taken by Mr. Hoyt, a government engineer, at which time he (Baldwin)

met Hoyt at the mouth of the Green River and helped him get up the Colorado River to Moab. On that trip they were stuck on sand bars in several places. He delivered a boat for Mr. Hoyt for that trip at the mouth of the San Rafael, taking the boat by truck from Moab to Greenriver, then down the west side of the Green River to the San Rafael. (R. 1187–1188.) Couldn't get it to the river in the truck, by a mile; thought would put it in the San Rafael; thought enough water in there to float it down to the river; six or eight hundred pounds of stuff in it; found out couldn't get anywhere; had to take it out and shove the boat on to the river, and carry the stuff to the river. (R. 1188–1189.)

The reason he didn't deliver that boat to Mr. Hoyt by taking it down the Colorado River and then up the Green, instead of bringing it overland was that it is about one hundred and twenty miles from Greenriver, the town of Greenriver to the junction, sixty-five miles from Moab down the Colorado, going downstream the longest distance and upstream the shortest, probably. Another reason is he did it was because it could be done cheaper and quicker taking it overland.

Has been on the Green River, on this last trip mentioned when tried to go up the Green with this power boat, the twenty-seven foot boat with the automobile engine in it. (R. 1189.) The boat they call their passenger boat.

Started up the Green, and hadn't gone more than about a quarter of a mile, and got stuck; the pro-

peller and the guards struck the sand; consequently the boat soon turned around with them. Thought would try it another place; tried it four times. Finally one of the boys got out with hip boots on, or boots that came up around his waist, and poled it upstream, let it dig its way through; got through that one; went on probably half a mile, or a mile and a half, the same thing over again, only worse. So it began to get toward night; discovered had only gone about five miles in five hours. That is as far as they went. Turned around and came back. (R. 1189–1190.) After having all of this trouble it was decided it would take too long to get up the river.

He has taken the Evinrude boat and the passenger boat about three miles above Moab on the Colorado River to Nigger Bill. From there on there are riffles and rocks in the stream. It would be foolish to attempt to get above Nigger Bill, in his opinion, because the propellers would be broken on big boulders. (R. 1191.)

These trips were made at different times but he doesn't remember the times of the year.

He doesn't know of any other supplies of merchandise of importance being transported on the Colorado except those by the boats of the Moab Garage.

The United States General Land Office party was down there; and they hauled some material for them, also camp equipment.

The Colorado River was frozen over during the winter of 1924–1925 from December until the last

of March. Since then it has not been frozen over, however, there are short stretches of the river that freeze nearly every year.

In 1926 he went downstream with a load of material, came back the next day, and the ice had jammed ahead of him so he couldn't get through. The boat taken on this trip had a pointed bow and it was necessary to take a line in order to pull out of the slush. That is the only time he has seen the ice jammed that way except in the winter of 1926.

The ice catches in the narrow part of the stream, piles up for a distance of possibly half a mile or more, and backs the water up behind it.

The ice jam spoken of remained in the river for four or five weeks. (R. 1192-1193.)

Cross-examination. (R. Vol. 6, pp. 1194-1211):

The ice condition in 1926 was similar to that referred to in 1925 except that it was a heavier flow of ice and it was necessary to use dynamite in order to get through.

The boat was gotten out of the ice jam, the same evening it was stuck, and taken back down to the Shafter No. 1 well, where it was left until powder could be obtained with which to dislodge the ice.

In obtaining the dynamite it was necessary to send to Grand Junction and two days were consumed in getting the powder back to Moab from the time the truck started. The powder was then taken down the river in one of the small boats and work commenced shooting the ice.

The boat was held up altogether for a week or ten days but was not in the ice that long.

After getting the powder down to the ice jam it took about four days to clear the channel. About three thousand pounds or a ton and a half of powder was used in effecting the work.

Before the powder was sent for the boat was turned around and an attempt made to break the ice with the paddle wheel but it was soon discovered the ice was too thick and some of the paddles were broken. It was therefore decided to abandon such a course and the boat was taken down to Shafer No. 1 well. (R. 1194–1197.)

In his best judgment about forty trips were made down to the oil wells and back in 1927 and thirty trips were made in 1928. All of the trips enumerated by him except those in 1928, were made with the big boat. In 1928 possibly twenty of the thirty trips were with the big boat.

Witness would estimate that there was an average of ten or eleven tons hauled per trip both down the river and back. (R. 1197–1200.)

In his opinion, if the boat were operated two or three times a week or every day, it would not be necessary for the members of the crew to stand on the front of the boat and test the depth of the water for purposes of navigation and had he felt that there was any serious menace or danger in making the trips he would have kept a watch at such times and while they were running regularly they did not have to watch out so much.

No other case during that entire period that he was navigating that big boat when he was stuck on a bar for any such length of time as that.

The next longest time he ever was stuck on a bar was when they were stuck one day at noon until the next day about eleven o'clock. The third longest time he ever was stuck on a bar was when they got stuck many times in the afternoon, had to stay there all night, camp out in the middle of the river. That happened a dozen times during that entire period. (R. 1207.)

In the ordinary operations of the boat when it was stuck on a bar for a short time it would probably have taken three quarters of an hour to get the boat free. It was usually necessary to take a line to shore to free the boat from a sand bar. This would happen about fifty per cent of the time. About twenty-five per cent of the time difficulties were not encountered on the trips either way, the down trip consuming about two hour's time and the up trip from six to seven hours. On the other twenty-five per cent of the trips more or less serious delays in navigation were encountered, that is, delays that would consume from five or six hours up to a day and a half in time. Some delays might not be over two and three hours.

The big boat and one of the small boats are still at the docks near Moab in readiness to haul freight or passengers as the occasion necessitates.

He did not know for sure whether he was to be called as a witness in the case until he received a final telegram at Omaha, Nebraska. (R. 1207–1211.)

Redirect examination (R. Vol. 6, pp. 1211–1215):

There is no business at the present time for the big boat and it has been idle for five or six weeks. The boat is never operated at night except for short distances when it is late getting in to port and the crew wants to come in to dock. Difficulty was encountered in docking at night because the distance to the bank and the docks could not be judged.

There have been times when the boat was tied up at the wharf near Moab for several days when it would be found grounded with sand washed all around.

The dynamite used in dislodging the ice jam in 1926 was trucked from Grand Junction to Moab and then taken down the river on the small boat, several trips being made with the boat in order to transport the three thousand pounds of powder.

The boats did not hit sand bars with force enough to explode the dynamite and therefore, no trouble was caused while it was being hauled. When the small boat got to the ice jam with the dynamite the channel of the river was completely frozen over. (R. 1211–1214.) All these boats that he has been testifying to were run for commercial purposes, that is, for profit. (R. 1215.)

LIEUTENANT COLONEL ELLIOTT J. DENT

For Complainant

(Record vol. 7, pp. 1217–1307)

He is a Lieutenant Colonel, Corps of Engineers, U. S. Army. He is fifty-two years old. Is a graduate of the United States Military Academy, Class of 1901; assigned to the Corps of Engineers, U. S. Army, and has risen from Second Lieutenant to Lieutenant Colonel in that Corps; was a full Colonel during the World War. His experience has included about twelve years with engineer troops, and the balance of the time on engineering work, mainly in connection with rivers and harbors; the Potomac, Rappahannock, James, Arkansas, White, St. Francis, Black, and Currant Rivers; the upper section of the Columbia River, that is, above Vancouver, Washington; a number of rivers in the Seattle district, the Sanohomith and Puyallup are the principal ones.

Has had charge of the mouth of the Mississippi River for several years, and a number of small streams in the State of Illinois, including such as the Chefuncte, Bogue Falia, Amite, Calcashiew; the Tennessee River, beginning about twenty miles below the Muscle Shoals Dam, and going downstream to its mouth. The entire Cumberland River.

In Michigan, the Saginaw and the Black Rivers; and has had charge of sea-coast harbors, New York City, Long Island, about six or seven harbors on the coast of Washington, and the Great Lakes channel

from Lake Superior, including the west end of Lake Erie; was on duty for over three years on the Washington filtration plant. (R. 1217–1218.)

From about August 25th to about September 4th, 1929, he made an official examination of the Colorado River. (R. 1218.)

With reference to crossing bars. A river is ordinarily a succession of bends, with more or less straight reaches at the point where the curvature changes. During a freshet a river ordinarily builds a bar at the point where this curvature changes. (R. 1219.)

In the reach where the change of curvature occurs, there will ordinarily be built during a freshet a sand bar. He is speaking now exclusively of rivers carrying a heavy load of sand in their bed. Gravel is a very different proposition, and rivers that carry no sand, or very little sand, do not behave in this manner. (R. 1219–1220.)

This crossing bar may at the end of the freshet be considerably above the low-water surface of the water. As the freshet plays out and the river begins to fall, a time comes when the river ceases to build the bar higher, and on the contrary, begins to excavate a trench through that bar, which will eventually become the low water channel.

The amount of excavation may be very considerable. He saw bars along the Colorado River where it is quite certain that the excavation reached four or five feet. In the case of the Arkansas River, he has come in contact with cases where it probably,

reached twelve or fifteen feet. In the Mississippi River, for a few miles below St. Louis, which he has inspected, although he has never been officially in charge of it, they consider that a bar which during the freshet stage does not build higher than the low water surface will cause no worry during the subsequent low water season. In other words, a river will excavate at least nine feet through that bar. In general terms, where the river is curving to the left, the deep water will be in the concave bend, close to the bank. (R. 1220.) For the trip on the Colorado River he adopted the plan that they would travel as close to that bank as seemed safe, in view of the boulders and rocks that had fallen off the cliffs into the edge of the river. As you leave a bend turning to the left, you are following the right bank, and as you enter the straight reach, the deep channel ordinarily follows down the right bank for a considerable distance.

As you enter the bend, curving in the opposite direction, or in other words, to the right, you can count quite confidently on finding deep water as soon as the bend begins. It also happens on many occasions that that deep water will extend far up along the left bank of the river. In other words, where the river is curving to the right, the deep water will be in that bend along the left bank of the river, and that deep water will often extend far up into the straight reach. Under such conditions the crossing bar frequently has a diagonal position attached to the right bank below the lower end of

the channel as you come down stream, crossing the river in a diagonal direction, and attached to the left bank above the end of the deep portion of the channel, which maintains in the lower curve which curves to the right. (R. 1221.) The main flow of the river in that upper bend curving to the left follows quite close to the right bank, but as soon as it encounters a straight reach of the river it may begin to spill over this bar toward the left bank, and if you have a straight reach of any considerable length, the bulk of water at the lower end of that reach may be on the left-hand side of the river instead of on the right, where it started out. This bar would ordinarily be built up during any freshet. It will occupy the same general position each year, but its form may be entirely different from year to year.

As the volume of flow crosses from the right bank to the left, if it crosses in a concentrated stream, it will dig out a fairly deep channel, a channel comparable to what you find at other points on the river. If, on the other hand, it spills over gradually, there is no assurance that there will be any water anywhere across such a bar.

Another case is when the upstream deep channel cuts off quite shortly. In other words, shortly after leaving the right bank—shortly after leaving the curve which is curving to the left, the deep water may terminate and the river may cut across to the opposite or left bank. (R. 1222.) Still other cases, the channel from the lower bend

which is curving to the right, the channel following the left bank of the river may extend only a short distance, or possibly no distance at all above the bend. In such an instance you have a long shoal, depending upon the length of the straight reach, and the channel may be most anywhere in that area.

The problem in navigation is that wherever the river changes curvature, it is necessary to change the course of the boat from one bank to the other, and in making that change it is necessary to, in general, cross a high stage bar which has been more or less cut out during the falling stages, and which may or may not have a good channel across it.

What he has just said applies to the Colorado River as he saw it; you do not always have the channel in the same place on these crossing bars at the same volume of water. (R. 1219–1223.)

Ordinarily every change in the stage of the river causes a rearrangement of these bars; and in addition to that the river is seldom at one stage long enough to acquire a permanent channel. In other words, it is constantly changed, even though the stage is not changed, but that change is ordinarily comparatively slow in the lower stages of the river. (R. 1223.)

He made two separate trips, the first beginning at Moab, Utah, and going down to just above the first cataract in Cataract canyon, of the Colorado River. Then, going up the Green River for a distance of five miles, then retracing the trip to Moab, Utah. On that trip he was accompanied by Mr. Archie D.

Ryan, an engineer of the general land office of Salt Lake City, and Virgil Baldwin was operating the boat, with an assistant boatman, Cecil Thompson.

His examinations of rivers have in the past been directed towards the question of existing navigability, existing commerce, possibilities for improvement of the river, cost of the improvement, and general economic aspects as to whether the river should be improved or not. Another type of inspection he has been accustomed to has been in connection with rules and regulations for navigation, which he has not paid any attention to on the Colorado River. In connection with those examinations they make ordinarily what is called a preliminary examination, and a survey, if necessary. The purpose of the preliminary examination is to determine whether a further investigation is necessary, and if such investigation is considered necessary, to ascertain such facts as are necessary to determine the scope of the future investigation or survey. The purpose of the survey is to develop an actual physical plan for improvement of the river, with its cost. (R. 1224–1[illegible])

By an examination into economic conditions he means that the improvement of rivers is a very variable proposition, so far as cost is concerned, and the amount of traffic existing, and potential, is a very essential item in determining whether a river should or should not be improved under Acts of Congress.

In connection with the consideration of a problem of navigation, the question of volume of transportation is very essential, and whether that transportation is of such nature as it would ordinarily follow the river route if such route were available. (R. 1225.)

Volume figures in the picture in this way. Vessel transportation is very expensive per trip, and unless a considerable volume of freight is available for each trip, the operation of the vessel makes the cost of transportation extremely high. (R. 1225–1226.)

The question of volume of transportation ordinarily resolves itself into how much transportation charge the traffic will bear. In some instances, very expensive transportation is justified; in other instances the competition of highways or railroads makes it impossible to develop water transportation unless the water transportation is cheap per unit of volume moved. (R. 1226.)

The Colorado River is quite permanently located between rock banks. It has very small opportunity to move sideways more than a few hundred feet. There were very few sections of the country where the river could have moved its full width without encountering the rock on the other side. For example, if the normal width from rock to rock is eight hundred feet, the river would normally occupy, say six hundred. There are places where the rock widens out so that the distance from rock

to rock is possibly twelve hundred feet, and in a few pockets it is perhaps as much as two thousand feet. He only recalls one such pocket, at the moment, and that is so-called Cataract bottoms, just below the junction between the Green and the Colorado rivers, and of course the basin at Moab, which is some two or three thousand acres in extent, largely bottom land. (R. 1226–1227.)

Within those rock limits, the Colorado River is exceedingly changeable. The bars along the side of the river—incidentally the term "bar" is used both to indicate alluvial deposit along the side of the river, or a submerged bar beneath the water's surface—the bars along the side of the river had small trees on them. He should say that none of those trees were much in excess of twenty years of age, with a few possible exceptions. One exception is this Cataract bottoms, Moab basin, and in the Glen Canyon section, the vicinity of Hite, and possibly a few others, but in general those bars had only comparatively young trees on them. In addition to that there were, along the Colorado River, very many bars of comparatively narrow width, say, less than one hundred feet, which had not been in existence long enough to even start a growth of willows. (R. 1227–1228.) There were very few cottonwoods, mostly willows.

Left Moab on August 25th, quite early in the morning. He notes that at 9.18 passed mile 59. (R. 1228.) The stream flow at Moab as obtained

from the Cisco station by telephone the night before was approximately six thousand cubic feet per second. (R. 1228–1229.) This was at Moab, to the best of their ability to estimate it. It is subject to the final official corrections and computations at a later date by the authorities in charge of that computation; simply got the gauge reading from the field man. (R. 1229.) The gauge is at Cisco.

They had the Moab Garage Company's so-called passenger boat. It has been testified that boat was about twenty-seven feet long, and five feet beam, which is substantially in accordance with his recollection. The boat in itself drew comparatively little water, but the propeller projected entirely below the bottom of the boat, and was in turn protected by a quite strong steel guard fastened to the back of the boat and to the boat in front of where the propeller shaft penetrated the bottom. The boat squatted a little under full speed. In other words, it drew more under full speed than when going at less. (R. 1230.) It ran quite smoothly until the water got to be in the neighborhood of two and a half feet in depth. When the water got to be about two and a half feet, as ascertained by a sounding pole which he carried himself, it became necessary to slow the boat down to about half speed. If the depth got to be about two feet, the boat dragged very perceptibly. If the depth got to about one and a half feet it was necessary for somebody to get out and help steer and push. Mr. Cecil Thompson, the assistant, had a pair of wading

boots, and got out from time to time when necessary, to help straighten the boat around, or more to steer it than to actually push it, as the propeller could do more pushing, than the men aboard. Left the landing just below the Moab bridge, and immediately encountered quite a serious bar. That was one of the few occasions on the trip where, having tried one channel they backed out and tried another approach in order to try to get across to the deep water on the opposite side. In that case tried both sides of the river, and eventually, merely dug their way across the bar. (R. 1231.) That is not a permanent bar; that bar might be in very good condition after the cut-out stage following a freshet. (R. 1231.) The bars ordinarily form in the same general locality with each freshet. There is a bad wash comes out just below the bridge, and undoubtedly that is a bad place in the river. (R. 1231–1232.) Although the bar forms in the general locality you do not find deep water in the same place or locality across the bar, the position of deep water changing from time to time according to the stage of water. During the cut-out stage, as the river is excavating a channel through the bar, it doesn't excavate that straight down; it ordinarily moves sideways in the course of excavation. (R. 1232.)

The Moab dock is at approximately mile 65½; he has a note of a seven-foot depth in that vicinity, and a note of a two-foot depth in that vicinity.

At about mile 64¾ he has note of a three-foot depth, and a note of a grounding along there, three-foot depth.

He has a note that at about mile 64 there was a bar with gravel and cobbles; incidentally that bar they got over very nicely going down, but had trouble getting over coming up.

Just above and just below mile 63 he has indications of groundings with a depth of one and one-half feet of water.

At mile 62½ he has a note of eight feet plus depth.

Eight feet was the greatest depth he could measure with his sounding pole. (R. 1233.)

The map he is using is the 1912 survey map and is Complainant's Exhibit No. 10. (R. 1233.)

The soundings he is giving are the soundings that were taken by himself. There are no soundings shown on the original map.

He has a note of four feet at mile 61; 8 feet at mile 60¼.

4 feet at mile 60.

4 feet at mile 59½.

He has a note of a grounding at about mile 57¾.

A grounding at about mile 57¼, with a depth of 2½ feet.

A grounding at mile 56—nearly 57.

Mile 56⅓ have a grounding with a depth of 1½ feet.

He is not distinguishing between groundings and getting stuck on bars. (R. 1234.) They are

practically merged into each other. He made no reference how serious the grounding was.

At mile 55½ a grounding, with 1½ feet, both up and down.

Sounding of 3 feet just above mile 55.

A grounding about mile 54½.

A grounding at 53¾.

A grounding at 53.

They passed over that point without grounding coming up.

Incidentally, these notes of groundings are not necessarily complete. In other words, he might have been doing something else on some occasion, that is, on part of the up trip. (R. 1235.)

In the vicinity of Mile 52 he has two soundings, showing 7 and 5 feet, respectively.

At mile 50½ he has a sounding of 5 feet.

At mile 49½ he has noted a heavy grounding going down, and grounding coming up.

Mile 46 note grounding.

Mile 44¾, sounding of 3 feet.

Mile 43½, grounding.

Mile 43, grounding.

Mile 41½, grounding, going up and down.

Mile 41, grounding coming up, none going down.

Mile 40¼, grounding. (R. 1235.)

Mile 40, grounding.

Mile 39, looks like a sounding of 6 feet.

Mile 37, a sounding of more than 8 feet.

Mile 36, sounding of over eight feet.

Mile 35½, sounding of 4 feet.

Mile 35, a grounding on the way up.

Mile 34½, sounding of over 8 feet.

Mile 34, a grounding.

Mile 32½, grounding coming up.

Mile 31½, sounding of 4½ feet.

Mile 29¼, sounding of 3 feet.

Mile 28½, a grounding.

Mile 28, 6-feet depth.

Mile 27½, 5-foot depth.

Mile 27, heavy grounding followed by depth of 8 feet and over.

Mile 26, depth of 6½ feet.

Mile 25½, depth of 3½ feet.

Mile 25, grounding.

Mile 24½, depth of 5 feet, followed by a grounding just below.

Mile 23¾, depth of 8 feet and over.

Mile 23, grounding.

Mile 22¼, bad grounding.

Mile 20⅓, grounding both up and down.

Mile 21, grounded coming up. (R. 1236.)

Mile 19¾, grounding up and down, followed by a depth of 6 feet, followed by three groundings between mile 19 and 19½.

Grounded at mile 17½, both up and down.

Grounded at mile 16½, having 3½-foot sounding in that same vicinity.

Mile 15¾, a grounding.

Mile 15⅓, depth of over eight feet.

Mile 14¾, grounding on the way up.

Mile 14⅓, grounding up and down.
Sounding of 7 feet, mile 14¼.
7½ feet, mile 14.
Grounding at mile 13¾.
Sounding, 3½ feet, mile 12¾.
Sounding of 7 at mile 12¼.
Grounding at mile 12 on the way up.
Grounding at mile 11½.
Grounding at mile 10¾, both up and down.
Depth of over 8 feet at mile 10⅓.
5 feet at mile 10.
Groundings at mile 9⅔.
Grounding at mile 9.
Grounding at mile 8⅔.
Depth of 4½ feet, mile 8¼.
Grounding at mile 8. (R. 1237.)
Depth of 5 feet, mile 7¾.
Grounding on the way up, mile 7½.
5 feet depth, mile 7⅓.
6½ feet, mile 6½.
3½ feet, mile 4½.
5 feet, mile 4¼.
Grounding just below mile 4.
3½ feet, mile 3⅓.
3½ feet, mile 2½.
7 feet, mile 2¼.
4½ feet, mile 2.
Grounding at mile 1¾.
Grounding at mile 1⅓.
¾ depth at mile 1.
3 foot depth at mile 1¼. (R. 1234–1238.)

He identifies mile points as shown on the map, (Compl. Exhibit No. 10) "by the topography, and following the bends, and the general character of the banks. For example, a very easy point to identify precisely is Indian creek at mile 16¾. At mile 15½ the map shows a hanging valley on the right bank.

At mile 14¾, shows a canyon on the right bank.

Mile 0 is the junction of the Green and Colorado Rivers. (R. 1238–1239.)

Proceeded on down—he is now on sheet M of the survey of the [Colorado River and its tributaries, Complainant's Exhibit No. 10, Sheet 13], the survey having been made in 1921. (R. 1239.)

The junction of the Green and Colorado Rivers is on Complainant's Exhibit No. 10 at mile 216½.

He noted a sounding of 3½ feet just below the junction.

3 feet at mile 215⅔.

8 feet plus at mile 215⅓.

4½ feet at mile 215.

7½ feet at mile 214¾.

7½ feet, mile 214⅓.

6 feet, mile 213.6.

8 feet plus, mile 213½.

4½ feet, mile 213.

7 feet, mile 212¾. (R. 1239.)

That is as far as they went, the first cataract being at about mile 212⅓.

Walked down and looked at the first two cataracts.

He is now referring to sheet 31 of Compl. Exhibit 10, which is the survey of 1914 of the lower Green River.

Retraced their course from up Cataract Canyon to the junction of the Colorado and the Green Rivers, and then made a short trip up the Green River.

He has a note of four feet depth at the mouth, this is mile 0 on the exhibit.

3½ feet a short distance above, a heavy grounding at about mile ½.

6 feet, a short distance above, 8 feet plus at mile 1.

5 feet at mile 1⅓.

3½ feet, mile 1½; groundings at mile 1¾.

6 feet, mile 2⅓.

8 feet plus at mile 2½.

3 feet, mile 2¾.

7 feet, mile 3.

4 feet, mile 3¼.

Grounding, mile 3⅓.

4 feet, mile 3¾.

4 feet at mile 4½.

Grounding just above, then 3 feet.

8 feet at mile 5. (R. 1240.)

As a matter of fact, it took four hours to go that five miles. The grounding was very heavy at about mile ½, and very heavy, as he recalls the point, at mile 3⅓. He believes the grounding at mile 1¾ was comparatively light. In one of those cases had a crossing bar of the type that he has first de-

scribed, in other words, a crossing bar which the deep channel overlapped by a considerable distance. Went upstream to the head of a deep pocket and they were unable to find any promising point to cross the bar. Retraced their steps, and tried to find some way of penetrating the bar in order to reach the deep pocket that extended down stream on the other bank. They turned around, and being unable to find a crossing there, went back up, pretty well up in the deep pocket to the down stream pocket, and manhandled the boat across, two members were out wading, and they spent a long time getting across. (R. 1241.) In connection with the navigation, the boat in which they were traveling had this propeller and skag at the rear end, which projected far below the rest of the boat, and was the first point to ground. When going up stream, if the boat was brought to a stand or slowed down sufficiently to lose its steerage, the grounding was at the stern of the boat, and the current swung the head of the boat around, and two men couldn't hold it in the current they had at that point. (R. 1242.)

The rudder's position is anchored and is the same depth as the skag. This skag or brace had an extension, including a socket for the rudder post. Then they retraced their way to Moab (R. 1242), arriving at Moab on August 28th (R. 1268).

The sediment in the Colorado River he personally observed by taking a tumbler they had emptied in the course of their consumption of

rations, and took samples of water at a number of points.

He found that there was a very considerable deposit of sand of a character that would settle through still water at the rate of one foot per minute, or greater.

Comparing that with his experience on the lower Mississippi River, the charge of sand was extremely heavy; that sand of that size is approximately one four-hundredth of an inch in diameter, or greater.

In addition to the sand which settled at this rate of a foot or more, and which in his experience is ordinarily quite troublesome, there was apparently about one equal quantity of sand that settled at the rate of about one-fourth that speed. Now, this solid settling sand could be quite readily carried in suspension, and would not make as much trouble as the coarser sand first mentioned. As to the quantity of this sand, the only indications he has are official records of the lower Colorado River in the vicinity of Yuma. (R. 1244.)

The gradient of the river, as shown by the maps, is over one foot per mile, with steeper sections that considerably exceed one foot per mile.

Basing his answer on the matters which he has already detailed, he knows of no other river in the United States of the character of the Colorado, as he saw it there, which is commercially navigated. (R. 1244, 1246.)

[Mr. BLACKMAR] I now offer to prove by the witness on the stand that he has been present during this hearing and has heard the testimony with reference to the operations of the boat of the Moab Garage which transported oil-well supplies from Moab down the river to several different points, and that in his opinion, owing to the excessive freight rates charged, also that the operations were of a temporary and of an explorative character, that such navigation or operation of the boat is not, in his opinion, commercial navigation. (R. 1249.)

The SPECIAL MASTER: Just add to that, "and that the witness will so testify." (R. 1255.)

He returned to the city of Moab August 29th with Mr. Archie D. Ryan and the chauffeur (R. 1250, 1252), and then he and his party "went overland by automobile to Greenriver town, where he inspected the first riffle below the railroad bridge on the Green River. (R. 1250.)

The riffle in question at the time of his inspection showed a very considerable drop in the water surface there above and below the riffle, which drop he should estimate at least two and a half feet. The water was running through at a very rapid rate. A number of boulders were showing above the surface of the water in spots, and the surface of the water indicated clearly that others were below the surface.

As compared to a survey of the riffle that had been made in 1909, the river had moved substantially its entire width. (R. 1250.)

At the time of his inspection the river was infringing on the point between Salaratus Wash, which enters the river just above that riffle, and the river proper. That point was caving off as witnessed by the fact that a number of trees had been undermined and were falling, or had fallen into the river, forming a series of snags along that bank. The indications were that the caving was still going on, and that in the course of caving it was excavating, or unburying, as it is sometimes termed there, snags and boulders. (R. 1251, 1252.)

He made no inspection of the river bed at Greenriver, as he had no boat there. So far as the changes in the channel are concerned, the only map he had was this 1909 survey, which has been discussed before, and the change that he noted previously. (R. 1252.)

From Greenriver he went to Hanksville by automobile, where they stayed for perhaps thirty-six hours; thence by automobile to the upper portion of North Wash [near the Colorado River], and at that point they were eventually overtaken by a wagon. (R. 1252.)

The road from Greenriver to Hanksville is a track across the desert. Sometimes no track; they actually had to break substantially a fresh track through among themselves, where the sand had drifted in and obliterated all previous marks. (R. 1252–1253.)

The road from Hanksville to North Wash is used considerably for about eighteen miles from

Hanksville, and is something like a well-traveled desert track. (R. 1253.) The road does not follow the line of the river; it leaves the river immediately. There is a road—a track or desert road from Hanksville to some mining communities in the Henry mountains. (R. 1253.) That is south of Hanksville and this road to North Wash follows that road for about eighteen miles. Thereafter it resumed the nature of a desert track, leading, as he understood, to certain ranches down in there, for a further distance of about eleven miles—they made that by automobile—then it drops into North Wash. (R. 1253–1254.)

The only other roads he saw in that region were a few tracks leading off, and from Hanksville there is a road leading west, the mail route leading west over the mountains somewhere, he doesn't know just where. (R. 1254.)

It is alleged that water runs all the year in the Dirty Devil River at Hanksville.

Except for the wagon that carried their boats down ahead of them to the Colorado River there was no indication of wagons having come over the road between the point at North Wash where the wagon joined them and the Colorado River at the mouth of the wash. (R. 1254.)

His boat was put into the Colorado River at the mouth of North Wash by Bert Loper, his boatman, and it was in condition to go downstream. (R. 1255.) In this case the boat was a skiff manufactured by the Evinrude Company for use with an

outboard motor. It was about sixteen feet in length, with a beam of about four feet, moulded hold, and a very pronounced keel. They had a Johnson two-cylinder outboard motor lashed to that, about eight horsepower, and they had two sets of oars. (R. 1256.)

The party left North Wash at 1.30 p. m. on the 1st day of September. He is now using sheet 12 of Compl. Exhibit 10, which shows the mouth of North Wash as about 167½ miles above Lee's Ferry, Arizona.

Miles on the maps to be referred to from here on are based on Lees Ferry, mile 0.

On this trip the boat ran smoothly when the water was over about a foot and a half in depth, and dragged thereafter.

Substantially no notes were made as to where the boat dragged, but it did drag very frequently.

On this trip there were only three of them. After they got settled down to running, the boat man, Bert Loper, kept a lookout in front indicating where the boat ought to go, or in case of necessity he took the oars. Mr. Ryan, who was with him, ran the motor and steered where Loper indicated, and he (Dent) spent a large part of his time baling.

There was a good deal of rain, and in addition to that they were pretty wet most of the time, making the keeping of systematic notes rather difficult, and the conditions were such that a general statement was all that appeared to him to be necessary. That is why no notes were taken by him as to where

boats dragged. Describing the character of the river in there as he saw it, and the progress, and so forth. They started at mile 167½. At mile 164 he has a notation of 2-foot depth.

Another notation of swift water at spots. He is now on sheet 11, Compl. Exh. 10.

At Hite, which is mile 162½, he notes a gravel bar.

At mile 160 to 161 he notes rapids.

At mile 159½ he notes rapids.

At mile 158¾ he notes rapids.

At mile 158 he notes rapids, and he makes a further note that a bar, visible bar alongside of there was covered with boulders. These were rounded boulders from gravel size up to perhaps two or three feet in diameter. (R. 1256–1257.)

At mile 157 he has a note, "Bad." By that he means probably swift water and rough water. (R. 1258.)

Sheet 10, Compl. Exh. 10. At mile 152 there is an island in the river which he notes was composed of sand and gravel.

Above the junction, or from Moab to the junction with the Green there was only two places, where they noted gravel in the river.

At mile 150 he notes rapids with boulders and cobbles.

At mile 148½ he notes rapids with boulders.

He has no further notes on that sheet, which extends to mile 137½.

He notes that the sheet got wet, from its appearance.

At mile 137 he notes a sounding of 4 feet, rock bottom.

Mile 134½ he has noted a grounding, for some reason.

Mile 132 he notes Smith rapids, cobbles and small boulders.

This is Sheet 8, Compl. Exh. 10. At mile 129¾ he notes a rapids.

Mile 126 he notes that they grounded.

Mile 124 he notes that they grounded, with a sounding of 1 foot.

Mile 119 he notes that they grounded, and again at about 117½ he notes that they grounded—at mile 116½.

He notes rapids at miles 113½ and at 113.

He notes rapids at mile 112¼, with a note, "Bad rocks."

He notes rapids at mile 109. (R. 1258.)

Rapids at mile 108¼.

Grounding at Mile 108½.

He notes rapids at mile 107¼.

Rapids at mile 105¾.

Rapids at mile 104, and at mile 103¼.

They are now approaching—Rincon which is a very noticeable mountain that comes two miles below where he is speaking of. In Glen canyon now; have not yet reached the San Juan. The San Juan is at mile 78; are now at mile 101 and a fraction.

He has a note in the section from mile 101 to 93, "Good river." (R. 1258–1259.) In other words the river was in good condition; there was no material stream that came in. The Escalante river is shown on this chart at mile 88.

At mile 87 he notes "Rock out in the river" as a permanent landmark, not as any particular danger to navigation. (R. 1259.)

At mile 78½, approximately, is the mouth of the San Juan river. This is Sheet 6, Compl. Exh. 10.

Beginning at the mouth of the San Juan river began to encounter sand waves, and he simply made a general note, "Sand waves," as covering the section from mile 78 to 74. (R. 1260.)

He never saw that phenomenon before. He will describe it as he saw it there.

In the first place, the sand waves as noted were always at points where the water was comparatively swift, and by taking soundings with an oar they found the water was comparatively shallow. As they observed one of those places, the phenomenon seemed to run through a rather distinct cycle. They would note that the surface of the water was very choppy, a series of little waves covering this, what might have been considered a very minor rapid point of swift water with a very choppy surface. (R. 1260.) Without apparent reason, or other warning, these waves, these chops, would suddenly develop into a series of well-defined, smooth, undulatory waves. They differ from ocean waves in that the waves are comparatively stationary, while

the water runs through at a swift pace, whereas in the ocean wave the water is comparatively stationary, merely passing through a small orbit, and the wave goes on. The line of the crest and troughs of these waves were ordinarily diagonal to the river; he should say they were pretty near at forty-five degrees with the axis of the river. They had an open boat, a skiff. (R. 1261.) He means at an angle of forty-five degrees, even when the river was running in a straight course; these waves did not cover a long stretch of river. The curvature of the river was not very essential. It was not caused by a bend; the waves were in general at an angle of about forty-five degrees, perhaps he should have said with the current.

Had a skiff with a freeboard of about one foot, and the length of the skiff being about sixteen feet, using those as measures.

He estimated that from crest to crest some of the worst of these waves was not more than ten or twelve feet; it was not as much as the length of the skiff; and that the height of the waves—of the crest of the wave above the trough was fully three feet. (R. 1261.) They ran from that down to the point where they had nothing but the chop. This smooth, undulatory form lasted only a very short time; he should imagine it was considerably less than a minute, perhaps not more than thirty seconds; then they broke, breaking up stream, and in another few seconds they disappeared and they had the choppy form.

He didn't succeed in timing that cycle, but one of their camps was within hearing of one of those sand waves; at the time they broke they made quite a roar, and part actual timing and part estimating, he should say that the time for the cycle was anywhere from fifteen to forty-five minutes at that particular point. They appeared to adhere to one section of the river, and to occur in cycles, the cycles taking from fifteen to perhaps forty-five minutes. (R. 1262.) The sand waves must have moved down the stream to some extent. It was undoubtedly a sand movement that was causing this surface wave motion, but the motion down the river was not fast.

In navigating these they turned the boat substantially into the trough, and simply the current carried them over wave after wave, with practically no rocking; and if they could catch this formation of the smooth form in time so as to get the boat into position, there was practically no difficulty. But if they were plowing ahead, expecting to go through a point where it was merely choppy, and the waves suddenly formed, before they could slow the boat down and the boatman take the oars and get the boat into position, they frequently shipped considerable water. (R. 1262, 1263.) He means that normally they rode the trough of the wave and simply floated down there sideways. They shut off the power, slowed down materially for those chops, and then if necessary, if the smooth form started to material-

ize, they shut the power off instantly, and the boatman took the oars.

There was no difficulty in getting through; they would drift through at probably three or four miles an hour. The current is swift wherever there are sand waves, and he doubts if any set of sand waves occupy more than one-third of a mile in length of the river.

He has a note of rapids at mile 68½.

He has sand waves noted at mile 63. (R. 1263–1264.)

He notes that on Sheet 5 (Compl. Exh. 10), camped over night in the vicinity of mile 54, and he has a note, "Sand waves breaking all night." That is the time when he attempted to time them; but night fell, and he couldn't see his watch. The following day, after leaving there, as they went downstream, he noted "Sand waves at mile 53." (R. 1264.)

He did not come upstream and did not see anybody coming up, so that he does not know from personal observation how they came up through the waves.

On Sheet 4 (R. 1264) he has a sounding of 1½ feet at mile 46¼. He has an indication of grounding and note of sand waves at mile 36. He has a note of sand waves at mile 31½. This is Sheet No. 2 (Compl. Exh. 10): No. 3 does not apply—No. 3 has branch canyons.

At mile 30½ or thereabouts, the Arizona-Utah line just crosses the low-water river—just touches—

becomes tangent to the right bank, the river at that point running east and west, then the river goes back into Utah, about mile 27¾, where it crosses the line running south, thence into Arizona.

He has a note of sand waves ½ foot at mile 25, which is in Arizona.

He has a note of repeated sand waves for mile 25 to 22. And on sheet 1 (Compl. Exh. 10) he has no notes whatsoever. That completes the trip into Lees Ferry. (R. 1265.)

In that stretch of the Colorado River they met one prospector at Red Canyon, which is at mile 150.

In that stretch of the river he did not see any other boats going either up or down stream but this prospector had a skiff that he would estimate as about twelve feet in length and he actually crossed the river and visited them; they stopped and talked to him one afternoon, and next morning he showed up at their camp.

He saw the wrecks of a few boats, small boats most of them. (R. 1266.)

He saw the wreck of a large boat right at the ferry, Lees Ferry; and in addition to that, there were the remains of a dredge way up the river, parts of the machinery having been placed on shore and having caved into the river, and other parts still remaining on shore.

The hull and the ladder was out in the river.

Comparing that section of the river with the section that he was on between Moab and the junction,

having in mind practical navigability, the Glen Canyon section is very much less navigable, practically, than the section above the junction, using the term navigation for such boats as were in actual use in the Moab to the Cataract Canyon section. (R. 1267.)

He did not see any other boats in operation on the Moab section of the river. The trip to Lees Ferry was completed on September 4th. Left boat there. (R. 1267.) From there they went by automobile to Salt Lake City, via Kanab. The landing at Lees Ferry is on the north side or the right bank. The bridge is about five miles below the ferry. (R. 1268.)

With regard to these maps that he had with him as any aid to the operation of the boats: For a good part of the time he had the map in front of him, and watched for the bends, changes in curvature, and by watching the contours, watched for places where excess slope indicated in general that rapids might be anticipated.

While he was not navigating the boat, or responsible for it, he did discuss appearance of the water surface with the navigator, and they exchanged opinions as to where the best water was likely to be found on many occasions. (R. 1269.) So far as navigating the boat is concerned, the only value of these maps is in giving a certain amount of warning as to what may be in store for you a short distance downstream.

To be of value to the navigator, a survey would necessarily have to be of an entirely different type than those maps. There is nothing in these maps to show where the channel is other than what may be anticipated as a result of noting the curvature of the stream.

Even if he had a chart like the Coast Survey chart, showing where the channel was in the previous September, that wouldn't have been of any assistance; practically none, because each freshet establishes bars in substantially the same general location, but the form of the bar established by one freshet is very different from that from another. Also, as the river falls, reaches a cut-out stage, it cuts out in one manner one year, and a different manner the next—or after each freshet. (R. 1270.)

Cross-examination (R. vol. 7, pp. 1271-1293):

His first trip was on the Colorado River between Moab and the mouth of the Green River.

He was instructed by the War department to report to the Department of Justice to assist them in the case now in hearing.

His instructions from the Department of Justice were substantially—the verbal instructions were substantially to make this journey over the rivers and be prepared to testify to what he saw. (R. 1271.)

With him on his trip from Moab down was Mr. Archie D. Ryan, of the General Land Office in Salt Lake City. He is an Irrigation Engineer with that office. With him also were two boatsmen, Virgil Baldwin in charge of the boat and his assistant Cecil Thompson. He left Moab August 25th, 1929.

He made the trip for the purpose of studying the characteristics of the river, including the bed and any sand bars or other difficulties of navigation that might be present. (R. 1272.)

He understood that this case involved the question of the title to certain parts of the Green, Colorado, and San Juan Rivers; that the matter of the title depended upon whether or not these rivers were navigable streams.

The thought was in his mind, and his particular instructions were to find the actual facts in regard to the river, and be prepared to testify thereon.

He did go, not because of any general interest of the War Department or special interest of the War Department in these streams at this time, but because of this litigation, and for the purpose of qualifying himself to be a witness for the Government in this case. (R. 1273, 1274.) That was his understanding of how he came to be detailed.

"The SPECIAL MASTER. I do not think it makes the slightest difference how he happened to be assigned. I assume any officer of the United States

Army in pursuance of his duty will testify to the facts as he understands them. I don't think it makes the slightest difference how he came into the case.

"Mr. BLACKMAR. Except for this reason, that the Army Engineers are the only engineers in the United States who study rivers from the standpoint of navigation.

"The SPECIAL MASTER. You can bring those things out in qualifying the witness. I do not think it makes any difference how he came into the case.

"I assume an Army Engineer will testify to the facts as he sees them." (R. 1274–1275.)

With the matters in mind to which he has just referred in his examination, he did endeavor in journeys over these rivers to investigate, observe, and make a note of impediments to navigation in so far as such impediments might show the limit of practical navigation under the existing conditions. (R. 1275.)

Mr. Archie D. Ryan and Mr. Bert Loper, who was the boatman for the trip, went with him on his trip down. (R. 1275–1276.)

The supplies carried with them were expected to last about six days—they would have. They had about twelve gallons of gasoline, weighing about eight pounds per gallon; an out board motor, total weight fifty pounds, three bed rolls, about one hundred and twenty pounds for the three; rations ten pounds a day, total sixty pounds; kitchen

equipment, and so forth, that would weigh one hundred pounds, and they had the three men. (R. 1276.) The aggregate weight of all three was five hundred pounds. Probably four hundred pounds of impedimenta.

They left North Wash at 1.30 P. M. on September 1st, 1929. Arrived 4.35 P. M. at approximately mile 154, camped that night at mile 148½. Traveled about thirteen miles that day, from mile 167 to approximately mile 154, in a little over three hours.

In a stretch between those two points they got off at Red Canyon and made a short visit there. He does not know how much of a visit. Red Canyon is at mile 150.

He does not know what time he arrived at mile 150, which was their boatman's former placer mine. (R. 1278–1279.)

They got out to look over his house and his camp he had maintained there. Camp was established before dark. They stayed at Mr. Lopez's former domicile one-half hour. That is where the one placer miner they met was located also.

They left September 2nd at 8.10 A. M., and camped that night at mile 92, and he does not know what time they arrived at mile 92. (R. 1279.) That day an hour for lunch would have more than covered it. (R. 1280.) Did not get off that day to make any investigations of the banks.

Left mile 92 the next morning, September 3rd, at 7.20 A. M. That day they spent from 10.17 to 4.40 visiting the Rainbow bridge, National Monu-

ment. At mile 68½ is where we left the river. (R. 1280.) They camped that night at about mile 54½, where they arrived very close to dark. They established a good part of their camp by flashlight. (R. 1281.)

Made camp that night later than the night before. It was pretty late. It was not so dark when they arrived at mile 54½ that a flashlight was needed to discern objects, but it got that dark very shortly, in twenty minutes to one-half hour while they were still making camp. (R. 1282.)

Left mile 54½ the next morning at 7.13 A. M. and arrived at Lees Ferry at 1.10 P. M. They did not make camp on that day, nor any side excursions, and he does not recall getting out of the boat at all between the time he started and the time of arrival at Lees Ferry. (R. 1282.)

He made no notation of the hour of arrival at the various camps except at Lees Ferry. (R. 1282.) The hour of departure is not quite as confusing as when landing when you have to do a whole lot of things. The object in making a notation of departure was for general information only.

In making that trip from North Wash to Lees Ferry, he would call it quite an adventure, when you ship ten gallons of water at one time, in one wave; that is quite a serious proposition. It was a highly uncomfortable trip, and while they didn't ship that much water at any other time, they were constantly shipping water. (R. 1283.)

A good part of the time it was raining, which added to the discomfort. (R. 1283.)

A skiff could make the trip—a skiff such as they had could make the trip without extreme difficulty. It could not come back up without any difficulty at all. (R. 1284.) He believes that novices who use the river are always accompanied by skilled boatmen. (R. 1284.)

He believes it would have been impossible to have gone back up in the boat, because she wouldn't have gone upstream against many of those riffles and currents; it would have been necessary to get out and push or tow her. There would be difficulty at every point he has indicated as a rapid, in his previous testimony, and most of the points where he has indicated sand waves. (R. 1284–1285.)

The gradient of the stream is very ununiform. There was one rapid where the gradient may have amounted to three feet in two hundred feet. (R. 1285–1286.) The elevation of the river at the point of take-off [168.6 North wash], 3,455 [feet]. (R. 1287.) The elevation at Lees Ferry is 3,120 feet. (R. 1287.) That is an average of exactly two feet to the mile. (R. 1288.)

He never was on that strip of the river before, and had never seen it under other conditions, and he has never been there since.

On his return trip to Moab he left the confluence of the Green and Colorado Rivers at 9.10 A. M. on August 27th. Stopped for lunch at mile 8. Camp

was made that night at mile 30½. He arrived there at 6.45 P. M. on August 27th and camped at that hour. (R. 1288–1289.)

While traveling up that thirty miles of the river he made some notations on his map during the day.

Start was made the next morning at 7.55 A. M., and no camp was made because they reached Moab. He does not know the time that he arrived there. The last note he has is passing mile 59 at 3.57 P. M. (R. 1289.) Moab is six miles upstream from that. (R. 1289.) On that day stop was made for lunch under a cliff, and ate and stayed in the boat. (R. 1290.) He arrived at Moab before dark. During that day's travel he made very few notations of that trip up. He was studying the river on the trip up with a different idea in mind. (R. 1290.)

He observed much more water on the river from North Wash down to Lees Ferry than from Moab to the confluence [of the Green and Colorado Rivers].

From North Wash down, part of the river was considerably wider than the stretch from Moab to the mouth of the Green. He is under the impression part of it was narrower. The maps would show. (R. 1290.)

He repeats that it would have been extremely difficult, and impossible to come up in the boat. There is no mental reservation. (R. 1291.)

Perhaps seventy-five per cent of the mileage could have been made up stream in the boat; the other twenty-five per cent there would have been

places where unquestionably it would have been necessary to get out of the boat and help it. (R. 1291–1292.)

The boat used is a U. S. Geological Survey boat; the same boat that was used by Mr. Hoyt the previous year from Greenriver to the mouth. He had an outboard motor, good as outboard motors go. (R. 1292.) Had considerable trouble getting it started, at times; ran quite nicely most of the time, afterwards. (R. 1292.) When he arrived at Lees Ferry it was running better than at any other time on the trip. (R. 1292.) Had no more trouble with it than he ordinarily anticipated with an outboard motor. They sheared a pin at one point; they sheared the pin which holds the propeller, and had to get off and fix that; that is not a particularly difficult job. The screw operated on a hinge. (R. 1292–1293.)

Further examination (R. Vol. 7, p. 1293):

There were shoals and rapids encountered there that the boat could not have passed going upstream with that engine, and he doubts if it could have with any engine, or with a combination of this particular engine and the oars, it couldn't have done it. (R. 1293.)

Recross-examination (R. Vol. 7, pp. 1293–1295):

The Colorado River is quite different above and below the mouth of the San Juan River.

Some of the rapids near the initial point, near North wash, where the worst local difficulties for

upstream navigation. (R. 1294.) He is under the impression that the worst rapid that was encountered below North wash was at mile 156½, but that may not have been the one. (R. 1294.) He means that was the point at which there were some short pieces of river that would have been more difficult to get through per foot of length than any other portion. All of the difficulties he encountered were local. (R. 1294–1295.)

Redirect-examination (R. Vol. 7, p. 1295):

When he spoke in answer to the question of making observations as he was going down the river or up the river, those observations did not contemplate stopping the boat for that purpose, except on perhaps three occasions; once to take a photograph, and at least twice to feel the nature of the bottom with a sounding pole. The other observations were made while the boat was being operated. (R. 1295.)

Further examination (R. vol. 7, pp. 1295–1307):

The rivers of the Southwest are very heavily laden with sand. The rivers of the Northwest are not so heavily laden, although they do carry some sand. The rivers of the West slope to the Mississippi valley; that is, the Missouri, Arkansas, and Red, are heavy silt-carriers.

By study he knows something about the rivers west of the Sierras. The Sacramento was very seriously damaged by placer mining.

As a general statement, it would be true that most of these western rivers carry sand in varying quan-

tities. (R. 1296.) And it is also true that the western rivers are all generally subject to precipitation from melting snow and to heavy rains in the late summer. (R. 1296.) So that, so far as those two elements are concerned, there is not anything that differentiates this river—leaving out the question of degree—from other rivers in the west.

The general tendency of a river carrying large amounts of sand over long periods of time, for a period of, say, thirty to fifty years, should be to fill up, speaking in human periods of time—should equalize, fill up at times and scour out at times, and should in human measurements of time be about the same.

The Missouri River below Kansas City, during freshets, builds bars and cuts banks and changes quite considerably. (R. 1297-1298.) During the cut-out stage the Missouri River frequently stops after it has excavated a channel not more than three feet in depth. If it was never dredged, then in low water around three feet would be the maximum depth over some of those bars between Kansas City and the mouth. (R. 1297-1298.) He is not familiar with the Snake River. (R. 1301.)

The gradient of the Colorado River in that section from Moab to the junction of the Green and Colorado Rivers is around one foot per mile. (R. 1301.)

The swift currents, of course, make the faster changes. The swift current builds a shoaler river.

The Colorado River can spread out between

canyon walls by merely filling up its bed a few feet above where it is at the present time.

Speaking generally, he would say the box canyon is eight hundred to a thousand feet, while the river surface is not there than six hundred. Moab to the junction, a distance, speaking from memory now, of, say sixty-seven miles, the river has a fall of, roughly, sixty-seven feet. (R 1361).

It is an unescapable law of nature that this river must create friction of sixty-seven feet, use up energy corresponding to a sixty-seven foot fall in going from Moab to the junction. If the fall were twice that great, it would be necessary for the river to create twice that much friction. The friction is an inverse function of the depth; the less the depth, the greater the friction per mile.

Therefore, with a swift river flowing on a steep slope with an abundance of sand with which to build a bed, the steeper the slope the more shoal the river. This have experimental data on that, also.

The steeper the slope the more shoal the river.

With a river flowing sluggishly, it will build its bed so as to have on an average a deep river. The Mississippi River in its lower section has a depth of around one hundred feet. It has more volume at Vicksburg than it has at New Orleans.

The Chuffalia, leaving at Red River landing, takes approximately twenty-five per cent of the flow.

His deduction from that is that the lesser velocity in that particular case, also something of a change in sediment, causes the river to build a different type of river. (R. 1304.)

As a hypothetical case: Supposing you had the same volume of water, less velocity, the bars would form more slowly with the same fall, the same volume of water but less velocity, but it would inherently require that the river have more width and less depth. The assumption of volume of water and less velocity includes that assumption.

If the river has the same volume of water, same slope, and less velocity, then it is an inexorable law it have less depth and more width.

A swiftly moving stream moves the sediment more readily, of course, than a slow moving stream. It moves it in places and then automatically drops it in eddies and points where, for some reason, it is possible for it to do so. (R. 1305.)

He would say that the swift river puts everything in a turmoil, the condition that you find at any time is a condition of maximum stability. In other words, the river stirs things up, and it falls into some accidental form. If that accidental form is a stable form, capable of resisting the forces of the river more than some other form does, then it lasts for a longer time, and they are more likely to find it when they are investigating.

The permanent form—every sedimentary river has a form that is so wide and so shallow that re-

gardless of slope, local slope—you understand a slope is not continuous, it is a series of steps—the permanent form is one that the local slope is unable to move sediment, which means a very wide and very shallow form, even though the slope is steep. (R. 1306.)

CARROLL EDWARD DOBBIN

For Complainant

(Record, vol. 7, pp. 1308–1337)

He is a geologist employed by the United States Geological Survey.

Graduated from Colby college in 1916, where he took three years of geology, then he took four years more of graduate work in geology at Johns Hopkins University, graduating with a degree of Ph. D. in 1924.

Since 1917 has been continuously employed in geological work for oil companies and for the government in this and other countries. (R. 1308.)

In 1926 he went from Denver to Greenriver by automobile, then south on the west side of Green River to where the Texas Corporation drilled a well at the head of Elaterite basin; thence descended into Elaterite Basin, proceeded east to within two miles or so of the junction of the Green and Colorado rivers. That was his first trip. (R. 1309.)

His second trip was in a boat from Moab to the mouth of Green River, thence up Green River a mile or a little more and returned to Moab. (R.

1309,) This trip was made August 4th to August 10th, 1926. (R. 1318.) In the same year but later, went by automobile from Moab down to Bluff, and later he came from Cortez over to Bluff by car. (R. 1309.)

In 1927 he went from Moab down nearly to Monticello, thence turned northwest and went down Indian creek with an automobile almost to the junction of the rivers. (R. 1309–1310.)

During the summer of 1926 he had under his supervision four field parties, two working coal north of the railroad track and two working oil, and in the course of visiting those parties and supervising their work he was over, either by boat or by horseback, a greater part of that area between the Green and Colorado Rivers. (That section of the country which lies toward the Colorado River from the wagon road which runs from Greenriver to Moab.)

That pie-shaped area between the Green and Colorado Rivers is occupied mostly by a horizontal strata consisting of solid sandstone, some of which are four or five hundred feet in thickness, below which occur shales, some limestones, and other rock, with the result that in an arid region such as you have there, where erosion is quick and rapid, when water flows it flows torrentially, and the cutting is straight down, not like you would have in a region, say in Wisconsin or Michigan or some place where the topography is rolling formation, contin-

nous rainfall; but the cutting in this country is straight down. (R. 1310–1311.)

Where you have those all native heavy sandstones and shale you have got the sandstone standing out on the Colorado and on the Green River side as pronounced escarpments, and with the exception of two or three places are inaccessible; there is one of those above the other, a series of them separated by shale slopes. (R. 1311.)

Such geological formations contribute to a certain extent to the silt in the Colorado and the Green Rivers. The heavy sandstones are not eroded, but between the sandstones are thick strata of red shale, which will erode very easily, and can be carried in the streams down the steep descent by torrential rains. (R. 1311.)

Coming southwest from Thompson the road forks, one road going west to Greenriver and one south to Moab. At the forks of the road is the post office or ranch and reservoir known as Valley City. In there there is marine shale at the surface, which is all covered with a slight deposit of wind-blown material; that is flat, nearly flat, and very rolling; but as you proceed southwest from there you get into very rugged country, with high sandstone buttes, mesas, and cap rock, over which is deposited a loose and very thin deposit of wind-blown sand. There may be a deposit of sand in one place to-day, and not be there to-morrow.

The vegetation on this flat southwest of Thompson is a little plant that he does not know the name

of. There was no grass to speak of on this area when he was in there, but the higher country to the southwest had scrub junipers and some other grasses that he does not know the name of, but out south west of Valley City, about the county line between Grand and San Juan counties, there is a small area on the divide between the Colorado and Green rivers—it is on the top of the divide—that is called by the natives in that country the Big Flat; that is rolling, and has a crop of grass on it which in the winter is used by the natives for their cattle, a certain number.

The rest of the country bordering the Colorado River and the Green River is almost barren of any kind of vegetation, though he was told by his guide, in the winter time he pastures some cattle down there in those terrible Bad Lands. (R. 1311-1312.)

He has not been over that area immediately across from the town of Greenriver, adjacent to the river bank of the Green River to a point where the road from Moab crosses the bridge across Green River. (R. 1312-1313.)

Now, on the west side of the Green River. They left Greenriver in Dodge trucks, and started south, on the west side of Green River; they started out on a truck from the town—fair road, and within a few miles they had to force their truck in wind-blown sand; they practically shoveled their way through wind-blown sand south for a mileage dis-

tance of ninety miles, to where the Texas Company drilled that well at the head of the Elaterite Basin.

The high lands on the divide are composed of wind-blown sand continually shifting, and the streams are cut almost straight down, with the valleys bordered by those horizontal sandstones which form precipitous and inaccessible escarpments. (R. 1313.)

The topography is practically the same as on the east side of the river, the rocks being the same age, the same strata, and being horizontal, so the type of erosion in that country is the same over a wide area. There is no folding of the strata except on the river where the two oil wells were drilled, the Kane Creek oil structure. (R. 1314.)

That is not down near Hanksville; they were directly west of the junction of the Green and Colorado Rivers. (R. 1314.)

He has never been to Hanksville. He was about ten or twelve miles west of the junction of the two rivers; and then went down over an escarpment, and walked east; they walked east six or seven miles that day. (R. 1314, 1315.) They entered that country about the first day of May and stayed there until the first of October, 1926. (R. 1315.)

The vegetation in that country, except on the divide between the major streams, was very sparse. Not being an agriculturalist, he can not give the names of the different types of grasses, but in the

eroded areas along the stream, major streams, there was practically no grass. (R. 1315.)

The wind-blown sand sculptures are the hardest stones. Some of the most prominent erosional features which the tourist is shown are caused by the blasting action of wind-blown sand on sand rock. (R. 1316.) This wind-blown sand to some extent contributes to the silt of the river.

They took a trip by automobile from Moab nearly to Monticello, thence down Indian Creek to the wells that were drilled in that general vicinity. (R. 1316.) They were in that country for a week in 1927. The character of the terrain there is practically the same as on the north side of the river, horizontal sandstones forming precipitous escarpments, narrow divides, very rough cap or buttes, mesas, spurs, pinnacles, needles, and other forms of erosion; a very inaccessible and rough country. (R. 1316.) There was a very good road, well traveled, south to Monticello, but the branch from that down Indian Creek was an old trail that led down to a ranch some miles, and from there the oil men had carried material into the oil wells over some trails they had made. (R. 1316, 1317.) These roads were recent; forded Indian Creek sixteen times, and had engine and carburetor wrapped up in inner tubes to keep them from getting wet. Below there, in the vicinity of the oil wells, got there with the car all right, but it was a very tortuous trails, and in low gear and second

gear, just maneuvered over the country at a very slow gait. (R. 1317.)

Between the Green and Colorado Rivers he saw nobody living except one man living on the road, the main traveled road north of Moab, right beside the road, and then there is a ranch at Valley City. Both are on the main road north from Moab. Those are the only people he saw. (R. 1317.)

He saw nobody living in the area on the west side of Green River. He understands there is a ranch or two on the river, but didn't get down to the river. (R. 1317.) He remembers one ranch in that Indian Creek country. (R. 1317.)

On the trip taken on the Colorado River from Moab, August 4th to August 10th, 1926, he used the sixteen foot Evinrude boat, equipped with a six horsepower Evinrude outboard motor, the boat drawing, he would say, about a foot and a half of water. (R. 1318.)

The party consisted of J. B. Reeside, Jr., and himself, besides which there were in the boat, two bed rolls, food for about a week, cameras and surveying instrument and a twenty-five gallon barrel of gasoline. (R. 1318.)

Prior to that time he had a great deal of experience with boats on salt water. He has handled motor boats before. (R. 1318.)

The purpose of going down the river was to examine the rock section, and they were in no hurry; to make mileage was the least thing they desired, so to speak. (R. 1319.)

Started out from the dock at Moab, and the first day they camped in the vicinity of the Kane Creek well, the Shafer Oil and Gas, the first one on the river; that is about eighteen miles south of Moab by the river. (R. 1319.)

Just below the Moab dock where the river makes a turn they had trouble with sand bars, both going down and coming up stream. We had difficulty going down the river where the stretches of the river were straight. On the bends had no difficulty, but they were grounded off and on all the time, clear from where they started down to the junction of the rivers.

In coming back they were able to go over some of the stretches where they got grounded when they went down, indicating that there were shifting sands in the river bottom.

On way down they had a river map. (R. 1319.) Reeside sat in the bow and noted where they got grounded going down and other features of geology; would stop, say, two or three or four hours at a place, collect fossils out of the limestone, measure the sections, anything of geological interest; where they took photographs or where they grounded. Reeside put down on that map.

Their experience from Shafer well downstream was just about the same as it was getting to that point; grounded on the straight stretches, and had no trouble on the bends.

One thing that interested them not a little was the fact that in grounding they always jumped overboard as quickly as possible in order to prevent the boat from settling in the sand; found if it stayed there a few minutes it would fill; had a hard time to get it off. So several times, when the boat struck, Reeside up in the bow just jumped out there and instead of striking sand at a depth of something like this [indicating], that would ground the boat (R. 1319–1320) he, Reeside, would go clear above the waist, indicating he was on the deep side of a bar, like these sand dunes on the surface; a surface sand dune moves up, the wind piling the sand over and over and over that way; in all probability the sand bar moves the same way; the middle and rear part of the boat would be grounded on the top of the bar; he would happen to jump overboard on the deep side; that happened several times (R. 1321).

This condition continued clear down to the junction with the Green River. He remembers a place near the mouth of Green River called the "Slide" where they camped there one night, and climbed the cliff on the right bank of the river as far as they could go; they went up fifteen hundred feet. This "Slide" is an accumulation of boulders in the Colorado River about one mile and a quarter or mile and a half up stream from the mouth of the Green River. (R. 1322.)

He is not able to express any opinion as to the age, in years geologically, of the "Slide." The last

great period in geological history to which a name is given is the Pleistocene, which was the age of the great glacial invasion of the northern United States and Canada. (R. 1322.)

From that time on they generally speak of it as recent times. (R. 1322.) He could not tell whether it is one hundred, two hundred, five hundred, or one thousand years old. He didn't study it; he would not want to give an opinion without having studied it. (R. 1322.) He doubts very much whether anybody could tell what year the rocks broke off there, unless the rocks were worn away by the process of weather or something. (R. 1323.) He does not know how much of the river bed that "Slide" occupies.

He proceeded on down to the mouth of the Green River from the Slide, and then went up the river about a mile and a half, or thereabouts, and then turned around and came back; and camped at the Slide overnight. (R. 1323.) The mouth of the Green River was as far as they wanted to go for the time being. (R. 1323.)

On the return trip upstream they had the same trouble with sand bars and groundings, very much so. (R. 1324.)

He found that these markings that he had made coming down were not of any value; got stuck going up on places they came over coming down.

Left boat at Moab, there at the dock for a while, then at the end of the season, some time in Septem-

ber—can't recall the exact date, or early October, it was taken over to Greenriver, and two of the boys who had been working under him in the pie shaped area took the boat and came from Greenriver around to Moab; that was Mr. McKnight and Mr. Nye. (R. 1324.)

This trip from Moab to the mouth of the Green River and return was made August 4th to the 10th, 1926. Mr. McKnight and Mr. Nye made a trip with the same boat and with the same engine that fall he was there; it was late September or early October. (R. 1325.) They went from Greenriver to Moab.

When he was through with the boat it was transported overland from Moab to Greenriver. He had bought this boat and the engine in Minneapolis from the Evinrude people and had it shipped to Moab. (R. 1325.)

Cross-examination (R. Vol. 7, pp. 1326-1330):

During the time of his study of the territory at the triangular section between the Colorado and the Green Rivers, and south of the road between Moab and Greenriver, Utah, he went from Valley City southwest to what they call the neck about four times with an automobile. That was as far as he could go with an automobile. (R. 1326.)

When he stated that in making his trips in that section that it was sometimes by boat and sometimes by road, he meant that when he said by boat he meant down the Colorado River from Moab to

the junction. (R. 1326-1327.) With reference to the use of a boat in this section he meant the one trip that he referred to in detail on his direct examination. There are no creeks or water on the land, so to speak, in that pie-shaped area.

Prior to taking that trip described in his direct examination, he made a short trip in his own boat from Moab down to the Shafer oil well, eighteen miles down stream, and turned right around and came back to Moab.

He only made these two trips, the long one and the little short one. The only boating he did on the Green River was a mile and a half above the junction, which he made on the long trip. (R. 1327.) That was the only time he was ever on the Green River in a boat.

The trip down the Colorado River in a boat from Moab was the reconnaissance trip to find out the geology, so the men who were mapping the area in detail and living in camps could see it later and know what was ahead of them. (R. 1328.) When going down the river in their boat they aimed to keep in "what we thought was deep water, irrespective of whether it was on the right or left bank."

They concerned themselves particularly with the channel of that river going down, so far as it would help them to get along in their boat. (R. 1328.)

The trip made down to the Shafer well and this reconnaissance trip were the first experiences they

had had on the river. (R. 1328.) They made soundings with an oar, and these soundings were made on the straight strips where experience a little further up showed them the water was liable to be shallow. (R. 1329.)

They kept the motor running as they proceeded down the river except when they grounded; stopped it when they grounded. (R. 1329.)

Did not aim to go slowly, so they could have ample time to look at the formations that they were passing on either side, because the rocks are so similar there, so horizontal, one can pass several miles of the river and still see the same rocks. So they would stop at places where there was a good landing, and measure the section there, or collect fossils, and that would serve for several miles down the river. (R. 1329.) While he is unable to remember accurately, it was several times a day that they got out of the boat to collect fossils or make a close inspection of the geology on either side of the river. By several times a day he means that they usually broke camp in the morning around half-past seven or eight o'clock, and probably up until noon they would stop once; maybe once in the afternoon; it varied from day to day. It depended on the rock exposures; it varied a great deal. For instance, at the Slide, they spent all day there, camped there at night the previous night, and spent all day there. (R. 1330.) They stayed at the Slide because they were measuring the section of

rocks exposed on the north side of the river, about fifteen hundred feet of rocks exposed there; that is where the lowest rocks in the particular area they were examining were exposed, so they measured them at that point, sampled them in detail, collected fossils, determined the thickness of the individual strata. (R. 1330–1331.)

Indian Creek oil well that he visited was located in creek bottoms back several miles from the river.

Exclusive of themselves he would say the load in the boat was about three hundred and seventy-five pounds. (R. 1331.) Loaded he estimates the boat would draw two feet. He was not able to tell where the channel was. (R. 1332.)

There was nothing that enabled them to locate the channel in the straight stretches. So that in the straight stretches they simply went downstream, with Reeside with an oar at the front, sounding, and in spite of that they grounded. Had no trouble at curves; they were inside. (R. 1332.)

In coming upstream he had difficulty with certain places where on the downward trip he did not have difficulty. He hadn't had any experience with motor boats except on the ocean. This was the first experience he had with a motor boat on any stream. (R. 1332.)

He does not know whether there is less difficulty coming upstream with a motor boat than going downstream, because the water is not pulled out from under the boat by the operation of the motor

as you go upstream, whereas it does have that effect at times going downstream. They were aground a great deal in a shallow-draft boat, going up and down the Colorado River.

When they became grounded they endeavored to shove off into deeper water. At times succeeded, at others had to push the boat several hundred feet, zigzag it across the stream and back and straight ahead to get into deeper water. That was in the straight stretches. (R. 1333, 1334.)

In all probability if he had been familiar with the channel he would have avoided a great deal of that trouble.

It was his opinion then, and always has been, that the trouble that they had in going downstream and in coming upstream was due to shifting sands; the channel was deeper coming upstream. He made no notes. (R. 1334.)

So far as he remembers he did not get stuck in any place coming upstream, where he had had no trouble going downstream.

There were three or four places where he had trouble coming downstream, but where he had no trouble coming upstream. (R. 1334.) The water flows quite swift in certain places, the boat doesn't always obey the rudder, and in all probability they were carried in there by the shifting current. (R. 1334, 1335.) While he has no recollection of the specific places there probably were places where he had encountered no difficulty going down-

stream, whereas he encountered difficulty coming upstream. (R. 1335.)

Further examination (R. Vol. 7, p. 1337.):

The purpose of their trip was to look for oil lands; he had charge of two parties down in there looking for oil lands.

They were there gathering data for persons who were making maps. The purpose of those maps was in connection with oil and gas exploration, exploration of oil, gas, and so forth, on public lands. One of the parties was under Mr. McKnight, the other one was under Mr. Baker, for the Geological Survey, Department of the Interior, A. A. Baker and E. T. McKnight. (R. 1337.)

HARRY AURAND

For Complainant

(Record vol. 7, pp. 1338-1380)

He resides at Denver, and is employed as geologist by the Midwest Refining Company of Denver. Has received a degree from the University of Colorado in 1912; been constantly in geological work. For a short period of time was doing both geological and educational work. (R. 1338.)

Three years prior to graduating, from 1909 to 1912, was employed by the Colorado Geological Survey, assisting in geology through the southwestern part of Colorado, and then in central Colorado. (R. 1339.)

He is familiar with the country in and about the confluence of the Green and Colorado Rivers, and the scope of his knowledge of that country is: That from 1921 up until 1927 he was employed by the Midwest Refining Company in geological work, and the greater part of his work was in a corner adjacent to the Four Corners, that is, the corners of Colorado, Utah, Arizona and New Mexico. This necessarily took him on both sides of the Colorado and Green Rivers, the area in between, and clear down into Arizona and parts of New Mexico. He has personally been over that country that lies between Moab and the junction of the Green and Colorado Rivers and on both sides of the Colorado River. (R. 1339.)

The character of the country there in general from Moab to the confluence of the two rivers consists of a high plateau area which has been deeply dissected by the various streams that flow into the Colorado. By that he means the Colorado River has entrenched itself to a great depth; these side streams have worked their way and cut their way down to the same level as the Colorado River. In like manner, the Green River has done the same thing, only on the upper reaches of the Green River; that part immediately below Green River have softer sediments, which have been eroded down with greater ease. The result is, have less precipitous banks to our streams, and the river is more accessible for some distance down the entire

lower reaches, and both streams have canyon walls which are very precipitous. Again find foldings of the earth—of the sediment at various places—which have formed archings of the rocks on the surface. These in cases tend to divert the stream, and they cause the stream to cut through, forming deep canyons. These structures are called anticlines in general, and the fills between the structure synclines. (R. 1339–1340.)

He is familiar with that part of the country that lies immediately south of the Denver and Rio Grande railroad and on the east bank of the Green River. That country is rather a high plateau, dissected by streams or run-off. The erosion on the west side of this, however, is much less abrupt than on the east side. It is a country of sand rocks or sandstones, as they call them, and shales. The shales are soft, leaving the harder sandstones standing out as ridges or cliffs throughout the area. On the top, and even on the west side, there are certain areas in which wild grass will grow, and cattle could graze on this wild grass between the Green and Colorado Rivers. (R. 1340, 1341.) As you approach a point about twenty-five miles, or twenty-eight miles above the confluence of the two streams, the country suddenly breaks off, drops a thousand feet in elevation, and you have a barren area which continues clear down to the confluence of the two rivers. That is the condition you find between the two rivers. (R. 1341.)

The upper strip of this pie-shaped plateau is one thousand feet higher than the lower stretch. The lower twenty-five miles breaks off and drops a thousand feet in elevation. (R. 1341, 1342.) There are horse trails, and some trails which have been aided by man, so they can get the cattle from the rivers up on to the high ground; they have built up rock at certain places to keep the cattle from slipping off the trails. (R. 1342.)

He identifies Compl. Exh. No. 145, being a volume of photographs which he took himself or were taken by R. C. Coffin, the chief geologist of the Midwest Refining Company, and are photographs taken along the Green and San Juan Rivers and adjacent areas which are contingent to one of those streams. (R. 1342, 1343.) The photographs are all numbered. These photographs were taken from 1921 to 1926, various times before this litigation started. (R. 1345–1347.)

No. 1 is a picture taken looking right into the anticline at the Kane Creek structure—No. 1 or Kane Creek. It shows the sharp, precipitous walls and shows the structure, shows the width of the river as well. He has pointed out that one or two trails coming into the lower country come through this notch, and that during the time they started exploration work at the Midwest Refining Company's well on this dome, that trail was the only one accessible; the other one was absolutely dan-

gerous, the hillsides being covered with ice at the time. Inaccessible to the river or to the country going from Moab into the country down the river. They were trying to get down to this structure to start operations; they had a very short time in which to do it, due to the fact they had contracts requiring them to start on a certain date.

Picture No. 2 is taken from this notch, and looks down on the Colorado river, and on the many square miles of Bad Lands on both sides of the river. The notch he means is the notch he referred to in the first place; the old trail, he has called it. (R. 1343–1344.)

Photograph No. 6 is a picture of the country dropping off one thousand feet, and this lower land extends clear to the junction [of the Green and Colorado Rivers]. (R. 1345.)

There are no roads south of the Denver & Rio Grande railroad in the pie-shaped section between the Colorado and Green Rivers and at the present time he knows of no proposed roads in that section. (R. 1347.) There are no roads south, adjacent to the Colorado River from and on the same side as Moab. No roads approached the river closer than ten to fifteen miles on the east; there are several roads that start out at Moab towards the southeast, and branches turn off coming down on the divides between streams, so they come within fifteen miles of the Colorado river, but none go to the river. (R. 1348.)

He has been on the Green and Colorado Rivers in a boat, but never on the San Juan River in a boat, although he has been along the entire course of the river except the lower three or four miles.

He has traveled in a boat that section of the Colorado River from Moab to the head of Cataract Canyon. He has been in a boat from that point up the Green river to what he terms mile post 34, and has been along the banks from mile post 34 to the town of Greenriver, itself. Parts of this same course he has been over several times. (R. 1348.) He has been on the Colorado River five times below Moab in a boat, (R. 1348.) He used one boat twice, the second boat once, and the Moab garage boat on two occasions. (R. 1349.)

The first trip he made in September, 1921, in a row boat and he went down as far as mile post 40, a distance of twenty-five miles from the town of Moab. He had no motor but a pole and oars. After he got to the point he abandoned the boat, tied it to a tree and walked back to Moab. (R. 1349.)

He had difficulty with sand bars coming down in the rowboat. At the mouth of Kane Spring Wash, below Moab; and two other places, one about a mile above the location of the Midwest Refining Company's test No. 1 [well]; that would be about milepost 48 or 49; and three times in the next four miles below the Midwest Refining Company's well; that would be at mileposts 41 and 47. (R. 1350.)

The next time he was on the Colorado River it was January the 24th to February 2nd, 1926. (R. 1350.)

On that trip he had a boat owned by the Moab Garage Company, about sixteen feet long, five feet wide; it would draw from twelve to fourteen inches of water, depending on the load; this was motored by a Ford engine, and the propeller was properly inclosed with a grill to keep them from injury on sand bars, and on ice and stumps. (R. 1351.)

His companion on that trip was A. Smith of Grand Junction, who had been in the employ of the Moab garage for sometime previous.

On that trip he went down to the head of Cataract Canyon, slightly over five miles below the confluence of the two [Green and Colorado] Rivers. Starting out of Moab, Utah, they were fairly heavily loaded; they had sixty-five gallons of gas and five gallons of oil with them; they commenced to encounter trouble after leaving milepost 39, which is the second camp of the Midwest Refining Company.

Prior to that time they had trailed the boat in part, and it had been drifting part of the way. (R. 1351.) By trailing the boat [illegible] means with a towline, because they were riding on the large freight boat of the Moab Garage to the structure. (R. 1351, 1352.)

Started in from mile post 39 to drive it under its own power all the way. Left big boat there. Going down, both the big boat and the small boat

encountered trouble at mile post—that is, in the way of sandbars—at mile posts 64, 63, 56, 46, 44, 33, 32, 30, 28, 26, and 2. These are miles above the confluence of the two rivers. (R. 1352.) At the time he made this trip he had a United States Geological Survey Map, Water Supply Paper 396 (1917), being a profile survey in the Colorado River Basin. He kept a record by means of notations of miles on that map, he knew where the main sandbars were, and he checked up at the time he went down. He mapped the whole way going down, so he knew. (R. 1353.) The object of doing that was two-fold—first, he was supposed to find if there were any geological structures and to study the geology down the Colorado River below Moab, and second, he made it a point to find out the navigability of the stream as far as to the mouth of Indian Creek, because they had acreage which they had hoped to drill in that territory. Those were his instructions. (R. 1353.)

From milepost two above the confluence of the two rivers had no trouble down to Cataract Canyon. From the headwaters of the Cataract Canyon they turned around and went up, back up to the confluence and up the Green River. (R. 1353.) Had sand bars that they encountered at eleven places on the Green River, at miles 2, 4, 14, 18, 20, 23, 24, 25, 27, 30, and 31.

At about milepost 18½ they encountered such swift water that it took them approximately an

hour and forty-five minutes to go upstream a distance of half a mile; and again at milepost 19½; encountered a very high stream velocity, so had a hard time; it was especially so because of the fact that they were forced in against the cliff, and had to go back downstream and fight up the stream again; no chance of towing or operating in any way, although had two poles on the boat which were twenty feet long. (R. 1354.)

Both the Colorado and Green Rivers were full of flow ice the whole time during the trip and the waters were too cold to get overboard and push [the boats when they got stuck]. (R. 1354.)

On the Green River he followed the geology and everything clear up to milepost 34, and the points designated are those at which they found trouble. (R. 1354.) He has given the full number of points, every point at which they encountered sand bars. A stop was made at milepost 34 because it was estimated they had just enough gasoline to go down to the confluence of the rivers and up to "lower camp." He did not stop there because they could not go any farther; as a matter of fact, got out and walked even beyond that point to save gas. He walked to the mouth of Upheaval Canyon from that point. The purpose of this expedition was to study the geology, the thickness of the sediment, the formation which came to the surface, and see whether they had any geological structures along the river such as they had encountered before, the four known

structures, and to see whether, as far as Indian Creek, whether the stream might be navigable. (R. 1355.) That was the purpose of the expedition, and to determine the navigability to the mouth of Indian Creek. (R. 1356–1357.) The interest in determining the navigability to the mouth of Indian Creek was because they had prospective oil areas on Indian Creek about ten miles east of the Colorado River, and this trip was made with the hope that they could see a way to get transportation to the river at that point. (R. 1357.)

They already had some claims on the river twenty miles below, but not down on the river as far as Indian Creek. It is there were existing claims were being drilled at that time, or about to be drilled on the east side of the river. (R. 1357.)

At that time they were using the large Moab boat to transport supplies as far as the first two structures, twenty-six miles down the river, their purpose being to see whether they could get landings, or whether there was a place they could get in and build a road from there on out. (R. 1357.) His company did not drill on the Indian Creek acreage but another company did. He knows of other wells being drilled up in Indian Creek and the supplies for them are brought in by truck from Moab. He has not been up Indian Creek from the Colorado River. (R. 1358.) He has been from Indian Creek down to the Colorado River, but not up. (R. 1359.)

The purpose of the trip made to examine the river was simply to determine means of transportation; had this same boat, Ford motor, of the Moab garage, meet them at that point; had made an investigation riding horseback into the Indian Creek country, and had left word, and had a man waiting for them at Indian Creek to carry them out. He wanted to see the country intervening. (R. 1359.) He engaged transportation back up the river. (R. 1359.) When he went into the country to Indian Creek and vicinity, part of his employment was to examine and determine whether to drill a well at Indian Creek if the freight could be brought down that way. He did not make a report to his company on it. He was accompanied by their chief geologist [R. C. Coffin (R. 1361)] and he presumes he [Coffin] did. (R. 1360.)

His experience on the San Juan River has been doing geology mainly along the banks of the river itself. He was in there at various times since 1921 to 1926 and he has covered the San Juan River from Farmington, New Mexico, to the Nokai structure, which is twenty-five miles east of the confluence of the Colorado and the San Juan Rivers. (R. 1359–60.) During the time he was there he saw no boats on the San Juan River. (R. 1360.) His company drilled a well in the vicinity of Elk Ridge, San Juan County, Utah, which is about twenty miles from the Colorado River and about one hundred and thirty-five miles from the town of

Moab. The tools, casing, and other supplies for drilling that well were taken by truck to Blanding, Utah, which is ninety miles from Moab and then they were hauled from Blanding, Utah, to the location which is about forty-five miles. (R. 1361.)

Cross-examination (R. Vol. 7, pp. 1362–1375):

He stated that the Elk Ridge field was about forty miles to the nearest point on the San Juan River and about twenty miles from the Colorado River and the approximate distance from this point on the Colorado River to Moab would be about 90 miles, that the character of the country between the Colorado River and Elk Ridge was extremely rough and rugged. (R. 1362.)

He stated that there was no road between the well and the river and that the altitude of Elk Ridge was 7,200 ft.; and that the altitude of the Colorado River at the point nearest Elk Ridge was approximately 3,800 ft.

The only place that he knew of where the Midwest Refining Company had any oil ground below the Shafer wells was on Indian Creek, located on the East side of the Colorado River. It must have been in 1926 when they had a contract in the Indian Creek district. (R. 1363.) Some contracts with a permittee to take over the permit in some way.

The point on the Colorado River at which Indian Creek comes to the river is about mile 16¾. (R. 1363–1364.)

He continued to make notations of the difficulties in navigation as he passed Indian Creek, [on trip down the Colorado River] on down to about five miles below the confluence, [of the Green and Colorado Rivers] and continued to make observations with reference to the difficulties up the Green River to mile 34. (R. 1364.)

He found other structures and put up notices of intention to make application for permit at several places below [Indian Creek] and the notations of difficulties coincided with the trip downstream and the finding of the structures. The structures noted below Indian Creek were one between miles 7 and 11 on the Colorado River and one at milepost 2½ on the Colorado River. A third on the Green River at milepost 32. (R. 1365–66.) By structure he means indications of oil, the formations are arched. It is that arching the average geologist looks for, they are capable of retaining oil. It is not positive. (R. 1366.) The more oil structures he saw, the more difficulties to navigation he noted and he was really interested in finding conditions that would indicate navigability, as much as to oil structures. (R. 1366–1367.) Did not indicate points where he had good depth and fine navigation. As long as the boat went all right, didn't locate them. The assumption was, where he didn't have bad water he had good water. (R. 1367.) In many places he noted deep water but not as an impediment in transportation. He

knows personally nothing about the Midwest Refining Company being a defendant in a suit instituted in the local federal court in Utah by the State of Utah and the Texas Oil Company. (R. 1368.) He knew where the permits his company were interested in were located and some of them extended into and under the bed of the Colorado River. They were permits issued by the United States. He has a permit in his own name that includes a portion of the bed of the Colorado River. (R. 1369.) This permit is north of Indian Creek farther up the stream [Colorado River]. On the trip he took over to the wells on Indian Creek and then down Indian Creek to the Colorado River, he arranged in advance to have the Moab boat meet him at the river and take him back to Moab. (R. 1370.) They gave them a great latitude in time. That was because he felt very uncertain as to just when they would be able to make it there. (R. 1370–1371.)

Neither Mr. Coffin or he had ever been between this location of Indian Creek and the Colorado River, in the first place. In the second place, it meant practically a day's ride from Indian Creek to the closest place they could have their car. And third, went from Indian Creek down to this structure where he put up the sign, the stake, went from there before returning or attempting to return by the river. (R. 1371.)

The boat that met him at the point was the 16-foot Ford motored boat and they went on down-

stream first, before they returned to Moab. The time he drove his automobile to the Indian Creek was about eight months later than this trip when the boat met him, and the road had been built into Indian Creek in the meantime. (R. 1372.)

On the occasion when he walked from the Shafer well up to Moab he didn't walk down because he wanted to see the formation in the river bottom which was not visible by going over the top. He could have walked down very nicely. (R. 1372–1373.)

He could not row upstream, he tried it, went up three miles and had to give it up. (R. 1373.)

He did not try to row back to Moab; simply started to row across the channel to a point where he could get up on the bank which was three miles above the place he had camped. He could not quite row up to this place and had to pull to shore a half mile below and walk up through the brush. (R. 1374.)

He first knew he was going to be a witness in the case in November, 1929. (R. 1374.) Had done no brushing up before he took witness stand; none whatever, except to prepare this album submitted in evidence.

Didn't discuss his testimony with any person before he went on the stand. Didn't discuss it even with the attorneys. He hadn't discussed what he was going to testify, what they were going to ask him, or what he was going to answer.

He gave the attorneys the book and showed them the book, that is all. (R. 1374–1375.)

Redirect examination (R. Vol. 7, pp. 1375–1376):

He explains that what he means by indications of transportation was simply to see if he could take a barge of the Moab Garage Company to the mouth of Lockhart or Indian Creek and make an anchorage and get drilling machinery from there to the point he wanted to take it. (R. 1375–1376.)

He did not find those indications of navigation. (R. 1376.)

Further examination (R. Vol. 7, pp. 1377):

He made the notations on the Green River up to mile 34, in contemplation of ascertaining whether he could bring supplies down from Greenriver to the junction and up to Indian canyon. That was one reason. The second reason was, they found indications of structure from a point right to the junction of the river, and again at two places above, up as far as he went.

So, if he had found that it was feasible to drill oil wells on the Green River, he was investigating the possibility of bringing supplies down from Green River as he brought down supplies from Moab, on the other river.

From his investigation, and his general expert knowledge as a geologist, he is rather pessimistic at the present time as to the presence of oil in the

country adjacent to these rivers. He might not have been at that time. (R. 1377.)

Recross-examination (R. Vol. 7, pp. 1378–1380):

He says that the geologists are quite wide apart in their conclusions in reference to this field. (R. 1378.)

He had no particular point in mind as to the destination of supplies that might be brought in, as it would be any one of the structures he might find; and he had this plan in mind when he left Moab, that was one of the purposes of this trip to determine the condition [of the Colorado River], with respect to navigability down to Indian Creek and also on down the Colorado and up the Green. (R. 1379–1380.)

When he left Moab he had in mind the matter of determining the question of navigability clear around on the Green. (R. 1380.)

FRANKLIN A. NIMS

(Vol. 7, pp. 1381–1420; vol. 8, pp. 1421–1466)

Resides at Greeley, Colorado; 75 years of age. (R. 1381.) With Brown-Stanton Survey expedition on Green River, in 1889; survey of railroad down Colorado River; one of originators of expedition and in charge, and photographer. Brown drowned in Colorado River; Stanton, engineer for party. (R. 1382–1383.)

Boats were clinker-built; cedar skiffs; 15 ft. long, 3 ft. beam, 24 inch depth with keep bottom. 16 men in party. Kept stenographic notes during trip. (R. 1384.) Compl. Exhs. Nos. 146 to 172, photographs taken on trip. Compl. Exh. No. 173 explains photographs. Compl. Exh. No. 174, transscription of notes. (R. 1384–1385.) Compl. Exh. No. 175, map, reproduction of Stanton's survey through Colorado River. (R. 1391–1392.) Expedition started from Greenriver, Utah. (R. 1383.) Second Expedition made November, 1889. Mr. Stanton in charge; purpose continuing survey discontinued July 1889, after Mr. Brown was drowned. (R. 1395–1396.) Vasey's Paradise is 45. miles below Lees Ferry. Did not see any other boats on Green or Colorado Rivers during trip. Some settlers at Home Ranch below Green River; another ranch below mouth of San Rafael. (R. 1396.)

Rapids and gravel bars between Greenriver and the mouth of San Rafael; 2 miles below Greenriver one boat struck a rock in a rapid, knocked two holes in it. Waded to shore and towed boat; oars would strike, shallow water. (R. 1397.)

Between mouth of San Rafael and Labyrinth Canyon, rapids, sand bars; jumped out and pushed boat clear; boats sprung seams and leaked. (R. 1397.) Lead boat struck bars, others steered clear and found another current. (R. 1398.)

Started with six boats, loaded too heavy; made raft and loaded with containers and provisions.

(R. 1398.) Sand and small rapids upper end of Stillwater Canyon. (R. 1398.) First rapid; some boats ran it, some portaged; Cook's boat and raft had difficulty; second rapid, raft got away, went down stream, broke up.

At end of Cataract Canyon three boats left; two boats lost in cataract. (R. 1399–1400.) Provisions lost; party divided up, five men in one boat with Mr. Stanton; balance in two boats went down to placer mines to get provisions. Arrangements to resupply at Lees Ferry, supplies to come overland from Kanab. (R. 1400.) Saw some from placer miners, 12 to 20 men working above mouth of Dirty Devil. (R. 1400–1401.) Half dozen buildings above Hite. (R. 1401.) Big rapid at Tickaboo Creek; two boats damaged. There is a bigger rapid at Trachyte Creek; all boats sprung leaks. Stopped two days repairing boats. (R. 1402.) One or more boats run onto sand bars every few miles. Down to Lees Ferry, rough water, might call rapids, but got through nicely. (R. 1402–1403.) Sand waves and high wind toward lower end. (R. 1402.)

First trip, left river at Vasey's Paradise, 45 miles below Lee's Ferry; pulled boats up and tied with rocks. (R. 1403.) Walked out of Marble Canyon to Houserock Valley; drove to Kanab. (R. 1403–1407.) Water settled in bucket to make coffee next morning. (R. 1408.)

Left Greenriver, November, 1889. There were three boats; 23 ft. long, 3½ ft. beam, 22 in. deep;

quarter-decked all around; built of oak with hickory ribs. Lifeline around outside; 10 water-tight compartments in bottom; draft 15 to 18 in. loaded. Were specially constructed. (R. 1409.) Launched on Colorado River, mouth of Crescent Creek; brought to that point by wagon from Greenriver. (R. 1410.) Party went from Greenriver to Crescent Creek across desert by wagon. (R. 1411.) No towns enroute; thunderstorm flooded camp at Crescent Creek, drowned two of horses. Did not see any ranches or people between Greenriver and Cresent Creek. (R. 1411–1412.) Boats shipped to Crescent Creek; did not want second dose of Cataracts.

Left Crescent Creek December 10; stopped Tickaboo Rapids; boats sprung leak at Trachyte. Water was lower, had trouble with gravel bars below. (R. 1414.) Placer miners working in Canyon; one man had been with Powell's expedition. (R. 1414.) Saw no other boats on river between Crescent Creek and Lees Ferry, except those belonging to miners; just row boats, sharp bow and stern. (R. 1415.) Did not see any power boats, nor boats of any kind hauling freight and passengers. Staked out placer claims. (R. 1416–1417.) Post Office at Lees Ferry. From placer claims to Lees Ferry sand bars and high winds and whirlpools were encountered. Rapids and riffles between Crescent Creek and Lees Ferry; boats ran all rapids. Would not try to take type of

boat went down river in back up from Lees Ferry; could not be done. (R. 1418–1419.)

Cross-examination (Vol. 7, pp. 1419–1420; Vol. 8, pp. 1421–1460):

Would not want to row a boat upstream on Colorado from Lees Ferry. (R. 1420.)

First Expedition, Mormon community and post office at Lees Ferry; main road from Utah to Arizona passed through. (R. 1429.) Road did not appear to be much of a road. (R. 1431.) "Through the Colorado River," page 258 "pleasant sail down the Green was his statement as an author's privilege indulged in for those articles; introduced words not in diary to make it a story. He eliminated troubles from the article. (R. 1433–1434–1435.)

Compl. Exh. No. 177, he wrote and it is called "Through Mysterious Canons of the Colorado." (R. 1437.)

Compl. Exh. No. 177, "Profile Negatives Canned" was written by him. (R. 1439–1440.)

Article "Through the Colorado River," page 259, "Smooth water" to Lees Ferry. (R. 1444–1445.)

Talus slopes from last Cataract in Cataract Canyon down. (R. 1445.) Article "Profile Negatives Canned," page 75, "uneventful trip" from mouth of Dirty Devil in so far as particular trouble was concerned; any one writing an article would have made a change. (R. 1449–1450.) Did not do any rowing up river. (R. 1451–1453.)

Compl. Exh. No. 178, view in Cataract Canyon. Compl. Exh. No. 179, Green River, upper part of Labyrinth. (R. 1456.) Compl. Exh. No. 180, between some of cataracts in Cataract Canyon. (R. 1456.) No quiet water between rapids; swift but smooth. Compl. Exh. No. 181, between rapids in Cataract Canyon. Compl. Exh. No. 182, picture, Cataract Canyon. (R. 1457.) Compl. Exh. No. 183, picture, in Glen Canyon. Compl. Exh. No. 184, portage in Cataract Canyon. (R. 1457.) Compl. Exhs. Nos. 185–186–187–188–189–190, all pictures taken in Cataract Canyon. (R. 1457–1458.) Compl. Exh. No. 191, coming in Labyrinth Canyon. (R. 1458.) Pictures taken to represent survey line; no picture on Green River, not surveying down Green. Photographs from Compl. Exh. No. 192 on, all practically in Cataract Canyon. (R. 1459.)

Redirect examination (R. Vol. 8, pp. 1461–1465):

At that time the only people living at Lees Ferry were Johnson and his wives and children. When he went down the river he got out of the river at Lees Ferry on the left-hand side and from there went up to Houserock Valley, a distance of about thirty miles from the river. (R. 1461.)

There was no road or trail over that strip of the country. From Houserock Valley he went to Kanab, but does not know the distance in miles. There was a building at Houserock, occupied by a man who accommodated people with meals and lodging and ran a post office.

He rode from Houserock up over the mountain, which was pretty rough, as it was just a country road. He does not know how large Kanab was, there being a church, a few stores, telegraph office, and post office there. (R. 1462.)

From Kanab they went to Milford, and from Milford to Salt Lake on the railroad.

The road from Kanab to Milford was pretty bad in places, being just a country road.

He does not know how far the survey line was eventually carried down through the canyon. He could not positively say that the line was carried as far as Lees Ferry on the first expedition.

He does not know whether or not at the time of the second expedition Mr. Stanton had any interest in placer mining in and about the mouth of the Dirty Devil. (R. 1463.)

Others staked out claims, but he does not remember who they were. (R. 1464.)

He did not continue through with the survey on his second trip, but left about forty-five miles below Lees Ferry. On that trip he left the river on the right-hand side, being carried out unconscious, because of an accident in which he had broken his leg. When he regained consciousness he was lying on the floor of Johnson's cook house at Lees Ferry. From Lees Ferry he went to Winslow, Arizona, where he was put on a train. (R. 1464–1465.)

Recross-examination (R. Vol. 8, pp. 1465–1466):

On the second expedition the survey work began about six miles below Lees Ferry and he continued until he met with his accident about forty-five miles below. (R. 1465–1466.)

LEIGH B. LINT

For Complainant

(Record vol. 8, pp. 1466–1509)

He resides at Weiser, Idaho. He is 27 years old. Until a few days previous he was topographic engineer of the U. S. Geological Survey. He is now entering the University of Idaho at Moscow.

He has had four seasons of experience as a boatman on the Snake River; two seasons on the Green River; one on the Colorado. He grew up on the Snake River and has been accustomed to handling boats since he was a boy.

He made his first trip on the Green River in 1921, starting at Greenriver, Utah. (R. 1466–1467.) The first part of the trip was overland, and hit the Colorado river at the mouth of the Freemont [*sic* Fremont] River; then a boat was brought in by wagon, by way of North wash, and used this boat as far as Bull Frog Creek; went out around to Greenriver and there we got three boats, Galloway-type boats. Took those on down the Green River through Cataract canyon; ran a line through Cataract canyon, then picked up their old line at Bull Frog, and worked on down and continued the work which Mr. Trimble and Major Fowler were

doing. (R. 1467–1468.) That was in the same year. On the first trip he left Greenriver, Utah, and went overland down to the Fremont River and ran a line of levels, a fly line across, and worked the Fremont River down to the Colorado; then kept right on working down the Colorado River. He arrived at the Colorado River in July but he does not know what day. (R. 1468–1469.)

W. R. Chenoweth was the chief of the party; a man named Clogston was cook; a man by the name of Phelps was truck driver and his helper was named Morgan; Mr. Tom Wimmer was with them below there. He has forgotten the rest of the names. (R. 1469.)

On that trip the one boat went from the Fremont River and worked to Bull Frog Creek which is above Lees Ferry and at the head of Glen Canyon [Bull Frog Creek comes in approximately mile 120.4 above Lees Ferry.—Plate 8, Complainant's Exhibit No. 10]. (R. 1469.)

They were on the river all the time; does not know the mileage, because he covered so much territory that year. (R. 1470.)

When he entered the Colorado River it was just about average water. They were working very slowly, because had to work on the side canyon doing topography up to thirty-nine hundred feet elevation, so would work as far from camp as they could, then would move camp. With this one boat it was very slow progress. (R. 1470.) He

had a sixteen-foot open boat drawing about six inches. (R. 1470.)

Encountered difficulties in the operation of that boat. There were lots of shoals in the river, and with the load which had in the one boat, it made it pretty difficult to get over some of those shoals. We had sand waves; had to be pretty careful on account of the load; that is all we had; if swamped that, were out of luck. (R. 1470–1471.)

When on the move there would be only two in the boat; there was not enough room for the whole crew. The rest of them went along the shore of the river and carried the line along; that is, the survey. In places had to cross back and forth on account of the bends of the river running into the wall. (R. 1471.)

On account of the shoals and sand bars it took time to pick a channel to float the boat through without getting stuck; had to get out and wade around, locate the channel. The main thing there was sand waves we had to watch out for, not to get caught in them with this load. (R. 1471–1472.)

He came away from the river on about September 10. The boat was left there for Mr. Wimmer to haul supplies down to the parties below. The supplies were hauled in by truck from Salina, Utah, "and from the point where the truck was left they were hauled in by wagon down Bull Frog creek to its mouth." (R. 1472.)

The Coast Survey was also working down the river. Mr. Hough was in charge. The Coast Sur-

vey Party, when they left the river, was still on Bull Frog Creek, and they went on down the river right after "we went out." (R. 1472–1473.)

When they encountered sand waves, and couldn't miss them, they would try to turn the boat parallel to the waves, and ride it through that way, float down sideways. If you hit the sand waves head on with an open boat you would probably lose everything you had. (R. 1473.) With a decked-over boat they generally hit a water wave head on; with an open boat, tried to get around what they could; if they couldn't, hit them head on—or backed into them, rather. (R. 1473.) The difference in effect on a boat between a sand wave and a water wave, in its operation, a regular water wave will break upstream; they are sharp; a sand wave will keep rolling. (R. 1473.)

By prearranged plan, a wagon and four-horse team met them at Bull Frog Creek to take them out. From there they went out to where the truck was stored, and from there went up to Salina, Utah. The truck was stored at a ranch up in there, in the neighborhood of forty miles from the Colorado River. He knows they all had blisters when they got there. (R. 1474.) They didn't carry the survey line down the Green River. Had no work to do there. (R. 1474.)

After they reached the Green River loaded up the boats; had a small Evinrude which they put on one boat; started down the river. (R. 1474.) The boat with the Evinrude motor was a sixteen-foot

boat about four feet beam; had about twenty-inch sides. They called it a modified Galloway-type boat; just a cheap boat. It drew from eight to ten inches with the load they had on it and in it. (R. 1475.) The motor was fastened on the back. The way the boat was decked over, the propeller wasn't very deep under water; when they started out they tried to tie the boats together tandem, but couldn't tow them that way. (R. 1475.) There was in the neighborhood of a thousand pounds in the holds of the boat with the Evinrude motor; there were two of them on the deck. (R. 1475.) The other two boats were sixteen-foot boats, rounded sides; called them lapped-side boats; they were riveted; the bottom was rounded just a little bit; had about thirteen inches flare—that is, rake, rather. That means that from the amidships it comes up; the bottom of the boat is not level. (R. 1475–1476.) The particular advantage of the flare is that it makes it easy to handle the boat; sort of a pivot to turn on. The boat was of the Galloway type, decked over. The ribs were of oak, and the rest of it was cedar or spruce. The draft of the boats was about eight inches loaded; they didn't draw as much water as the other boat. (R. 1476.) Mr. Chenoweth was in charge of this party. The purpose of the expedition from Greenriver down was to run a river traverse from the junction of the Green and the Grand [Colorado] river through Cataract canyon and on down as far as Lees Ferry

for the purpose of a proposed reservoir site. (R. 1476–1477.)

In making the trip overland from Greenriver down to the Colorado River the ranches and people that he saw in that territory consisted of a small ranch at where the road crossed the San Rafael River, and at the foot of Henry Mountain there was a small ranch there. That would be approximafely thirty or forty miles from the Colorado River. (R. 1477.)

When he got down on the river [the first trip] a man by the name of Cornelius Ekker and his boy brought the boat in; they were the first ones they saw; and then at Hite, Utah, there was a man named Tom Humphrey, who had a small ranch there; didn't amount to much. It was very small. (R. 1478.) He saw no placer miners in there and no boats carrying either freight or passengers. (R. 1478.)

With respect to the trip from Greenriver, Utah, down the river, the progress of this expedition from Greenriver to the mouth of the San Rafael, they had these difficulties. They left Greenriver approximately the middle of September. They tried the boats tandem; they wouldn't work that way, so they tied them side by side; the boat with the motor on was tied in the middle; then the whole crew scattered around on the deck.

Before they got to the mouth of the San Rafael they hit a few shoals, few small sand waves, and

had to keep one man on the lookout for channels, and the river had just gone down. (R. 1479.) It was approximately the middle of September; lots of shoals in there then, after this high water deposited lots of sediment, new bars; at the mouth of the streams coming in rocks had been washed in; on account of the sediment in the water they couldn't see the bottom. (R. 1479.) Several times it was necessary at that stretch of the river to go overboard and help push the boats along. (R. 1479.) Between the mouth of the San Rafael down to the end of Labyrinth Canyon there was more sand, more shoals than there were above, on account of the recent high waters in the San Rafael river. He was pilot, at that time, of the boat with the Evinrude motor. (R. 1479–1480.) And from his experience upon rivers, he always tries to pick where the deepest water ought to be. The signs he looks for in the operation of your boats are generally the current and the drift. Do not always find the deeper water that way in that river.

Had the same trouble in Labyrinth Canyon. Had men overboard to push off.

They were all about the same in Stillwater Canyon below the mouth of the San Rafael. The situation in Stillwater Canyon was practically the same as Labyrinth; also like to state there was so much sediment in the water at the time we left Greenriver that the packing in the pump of the motor lasted only about two hours; cut it out. So

they took a five-gallon can, sat on the boat—connected the hose with it, and one man had to sit there and dip water for one hundred and twenty miles, to keep the engine cool; that is, pour water into the can and siphon it through the engine. (R. 1480–1481.)

Just above the confluence of the Green and Colorado Rivers he hit a bar, hit some sand and broke the propeller shaft of the motor. Left it on until we made camp that night, just below the confluence of the two rivers.

Then they took the motor off, and put it in the hold of one of the boats. (R. 1481.) Did not use the motor from there on any more.

Would not have tried to bring same boats up that stretch of the river from the commencement of the cataracts in Cataract canyon up to Greenriver, Utah, with the same equipment that he had.

He was brought up on the Snake River and operated boats all of his life. (R. 1483.) Had experience on the Snake river where he lives ever since he was little boy; also on the Weiser river, which runs into the Snake river at my home.

The progress of the trip through Cataract Canyon was comparatively slow, because he had to carry the line of traverse through at the same time, as he went through with the boats. Ellsworth Kolb was the head boatman; Emory Kolb had his own boat, taking pictures, and he helped. (R. 1484.) The rapids were looked over before the boats were

run. Drift was thrown in at the head of the rapids, to pick out the best channel through the rocks, and by very careful work we were able to get to the last rapid in the canyon without smashing up a boat.

At the last rapid, or next to the last one, Emory Kolb was running one of the boats through, and he ran on a rock. The boat was there approximately two days; had to throw a line out to him, a small line, had a big rope ashore; built a tripod, put the rope over it, rigged up sort of a pulley, and got all the equipment off the boat. It took them all the next day, then, to get the boat off the rock.

As he remembers, didn't portage any of the rapids in Cataract Canyon; but wouldn't say for sure. (R. 1485.)

Going down that canyon there are talus slopes, large boulders on one side or the other on which a portage could be made. He believes there are talus slopes on one side or the other all the way through. There are no box canyons except at the last rapid, there is one there that is boxed. (R. 1486.)

From the end of Cataract Canyon they went on down to Lees Ferry. Describing that trip. Had already had the traverse run from the mouth of Fremont; on the previous trip we had worked that, so they tied in our line at the Fremont River, went on down as far as Hite; they tried to repair the motor. Didn't have the material to repair it, so went

on to Bull Frog Creek and picked up their line there; that is, their line of traverse, and worked on down to somewhere around the mouth of the San Juan River, where Mr. Trimble was working; there were several parties working in that neighborhood; they just joined up with their work. But as soon as they got out of Cataract canyon the Kolbs took the boats, except one; they only had the one boat from there on down, one of the larger—one of the sixteen-foot boats. (R. 1486–1487.) Through Glen Canyon to Lees Ferry had shoals, sand bars, sand waves from there on down; had larger sand waves in there than we did on the Green River. (R. 1487.) The stretch of water at that time was much lower than when he was there the first time. There were also more shoals and sandbars. Ran into rapids there. Necessary for someone to go overboard frequently. (R. 1487.) Carried enough supplies from Bull Frog Creek to get through Glen Canyon, on the second trip. Left supplies there and just picked the supplies up. (R. 1488.) Both trips were made in the same year. He was in Glen Canyon in October and got to Lees Ferry around the first of November. When they got to Lees Ferry they left the boats there. The work was in cooperation with the Southern California Edison Company; they wanted to use the boats later; they built a boat house at Lees Ferry; those boats were left there. (R. 1488–1489.) On the second trip from Greenriver, Utah, down to Lees

Ferry we passed several bars with houses on, but does not remember seeing anyone along the river. (R. 1489.) Stopped at Hite on the south trip and Tom Humphreys was there. Hite is 162 miles above Lees Ferry.

While working on that stretch of the river he saw a large flat-bottom boat of the Edison Company; it had a stern wheel on it; they were hauling supplies from Lees Ferry up to Mr. Fowler's camp, which he believed was at the Crossing of the Fathers. (1489–1490.) It was about thirty feet long, with ten or twelve foot beam. He doesn't know the draft.

When they got to Lees Ferry, the Edison Company had a truck to meet them, and loaded their supplies in it, what we had left, started out; got about ten miles, and the truck broke down, and two of the men walked out to Conner's trading post, phoned in to Flagstaff, and had another truck come out and get them. Then the party broke up. That was the end of that trip. (R. 1490.)

The next time he was on the Green River was in 1922. Mr. K. W. Trimble was in charge of the party, which started at Greenriver, Wyoming, and continued to Greenriver, Utah. The same type of boats as used before, the Galloway type boats, being the same size and with the same draft, approximately, were used on this trip. (R. 1490–1491.) The members of the party included Bert Loper, head boatman; John Clogston, cook; Mr. Woolley,

of the Water Research branch; Mr. Stoner, of the Utah Power and Light; Mr. Reeside, the geologist; Mr. Blake was boatman, and he, Lint, was a boatman. (R. 1491.) The purpose of the trip was to run river traverse for a map and also for dam sites. Started in with the traverse at Smith's ranch. (R. 1491.) Went with the purpose of surveying any possible reservoir sites which they ran across. (R. 1492.) The possible reservoir site that was surveyed in the 1921 trip was at Lees Ferry, Arizona. Had plenty of rapids through there [Split Mountain Canyon], kept us pretty busy. (R. 1492.) From then on down had these difficulties. In Hell's Half Mile had plenty of difficulty there, had to portage; they carried all the equipment around; ran the rapids with empty boats, and Mr. Loper and Blake got through without any serious trouble; Mr. Loper hit his boat on a rock, and a wave set his on top of one; they had to throw him a rope. Took considerable time before he could get the boat pulled off the rock. (R. 1493.) This was in Lodore Canyon. In Desolation Canyon they encountered rapids just the same as the rest of it; it was all rapids.

Lees Ferry, when they were there, there was one man living there, the water resource branch gauger; his name was Cockrough; he, Cockrough, also ran the ferry there; when anyone came to cross, he would take them across on the ferry. It was a cable ferry. (R. 1494.) Just before they got

there, a bunch of boy scouts had gone across; the ferry sank with them; they lost both cars, but the gauge man had his canoe out there and he pulled them all out; no one was drowned. (R. 1494.) There were no stores or anything of that kind at Lees Ferry. (R. 1494.)

Cross-examination (R. vol. 8, pp. 1495–1510):

In the 1922 trip that he made with Trimble down to Greenriver, Utah, he got through. They had three boats.

On the 1921 trip he worked down the Fremont to the Colorado, thence down the Colorado. He did not have a boat on the Fremont. The boats were first used in running the survey at the mouth of North Wash. They were not there when he arrived and they had to wait several days for them, and while so doing worked up North Wash. Ran the line as far as Bull Frog Creek, which is above the mouth of the San Juan. (R. 1495–1496.)

[Mr. HOYT: It is 120.8, about, above Lees Ferry. North Wash is 167½. (R. 1496.)]

They used one boat from North Wash to Bull Frog Creek; that was all that was used on that trip. There were six in the party. While on that trip they encountered Cornelius Ekker and his son, and Tom Humphreys at Hite. Mr. Wimmer was with their party; he was working in from the other end. He was not one of the five referred to. He wasn't with their party; he was connected with it, but he wasn't with them. There were two

others with Mr. Wimmer. He met Mr. Wimmer for the first time at Bull Frog Creek. Mr. Wimmer came down Bull Frog Creek from Salina with the truck, but he did not bring a boat with him. (R. 1497.) These men were not with the boating party, merely a supply party that brought in supplies to the mouth of Bull Frog Creek.

He saw Mr. Wimmer more than once, and he was there in camp with them until he left. He doesn't remember whether or not he left Wimmer at Bull Frog Creek when the expedition was finished. (R. 1498.)

Did not see any other boats on that first expedition.

Tom Humphrey had one, but didn't use it, a small boat. (R. 1498.) It was a row boat.

He saw a mining dredge at the mouth of Bull Frog that was not in use; it was abandoned. He saw no boats on the river. There were no signs of places where the dredge had been working.

He left the boat there at Bull Frog Creek for Mr. Wimmer to use in hauling supplies from Bull Frog to where they were needed below, when they come back through, down through the Cataract; this boat was left there [on the first expedition 1924] before they came through Cataract canyon. (R. 1499-1500.)

Mr. Wimmer was in the employ of the government. He was not to take the supplies down to the Coast Survey Party. The Coast Survey Party had their own outfit.

The second trip was the one where he started from Greenriver, Utah, down the river. (R. 1500). He left Greenriver, Utah, approximately the middle of September. There were three boats in the party, one of which was equipped with a motor.

On the way down from Greenriver to the head of Cataract Canyon he made camp four times; it took about five days to make the trip. Doesn't remember the time he left Greenriver nor where they camped the first night; doesn't believe they were down below the San Rafael the first day. He doesn't have any recollection of where they camped the second day. (R. 1501.) Camped on the left side of the river on a big bar. That was about half way between Green River, Utah, and the junction. (R. 1502.) This was about the third night out of Greenriver. The only recollection he has about it is the distance concerned. (R. 1502.)

He doesn't remember any place he camped on the river down below that until he reached the head of Cataract Canyon. He believes it took three days to go from there [the last camping place on the bar] to the head of Cataract Canyon. The distance from Greenriver, Utah, to the mouth of the Green River is approximately one hundred and twenty miles as we had it figured out then. (R. 1501.) No lines were run to the junction of the rivers [on that trip].

He made no investigation of any character along each side of the river as he went down; it was merely our job to get to the junction of the rivers and start to work.

After he got to the end of Cataract Canyon on that trip, he saw no boat except their own until they stopped at Hite, where they saw the boat Tom Humphreys had there; camped there overnight. After he left Hite, the next one he saw was tied up at Hall Peng Creek. After that the next boat he saw was the Edison boat, with a stern wheel on it. (R. 1304.) The boat was approximately thirty to forty feet, had no appurtenance with it, just camped there overnight where it was tied up. (R. 1304-1305.) This was at the Crossing of the Fathers, he believes.

He saw some small residents at Lees Ferry, the Water Resources branch had there, and some the Edison Company had there. There were all row-boats and one canoe. He doesn't recall seeing any motor boats or gasoline launches. (R. 1305.)

Left their boat at mouth of Fremont; the rest of them were already there. Left their boat there for the Edison Company. (R. 1305.)

He believes that the Edison Company planned to do some work on the proposed Lees Ferry dam, which was approximately three miles above the ferry itself; there is a horseshoe in the river, Horseshoe Bend. That was the dam site. They would have used those boats on work on this dam.

site. (R. 1506.) Not at any other place he knows of. (R. 1506.)

The big boat up at the Crossing of the Fathers was used for hauling supplies to the camps, Mr. Fowler's camp and a man named Leach. Mr. Fowler's camp was on the left bank going down from the Crossing of the Fathers; that would have made it on the east bank, and at the Crossing of the Fathers, as he remembers it. (R. 1506.)

The other place where they were hauling supplies was upstream from the Crossing of the Fathers. He doesn't know how far upstream.

The reservoir site at Lees Ferry was designed to back the water up close to the junction of the Green and Grand [Colorado] Rivers, up to the thirty-nine hundred foot contour. (R. 1507.) The surveying of that reservoir site was one of the purposes of going there.

When they got through at Lees Ferry he went by truck to Flagstaff, and on the way the truck broke down. (R. 1508–1509.)

Further examination (R. Vol. 8, p. 1509):

To a certain extent this survey was confined to a traverse; it was traversed to where we hit the thirty-nine hundred foot contour. From there it was all topography, river traverse and topography. This survey is a portion of Complainant's Exhibit No. 10. (R. 1509.)

FREDERICK S. DELLENBAUGH

For Complainant

(Record vol. 9, pp. 1514–1596)
(Record, vol. 12, pp. 2230–2232)
(Record, vol. 25, pp. 4292–4314.)

The witness resides at New York City, is 76 years old, by occupation is an artist and writer, and earlier was a topographer with the Powell Expedition. (R. 1514–1515.)

He joined the Major Powell Expedition as topographer in 1871 on exploration and topographical survey work, starting at the Union Pacific Railroad Bridge [Green River], Wyoming, and it took the expedition seven months time to descend the Green and Colorado Rivers to Lees Ferry, Arizona.

During the winter of 1871 and 1872 he was occupied in making topographical surveys through the country adjacent to the Colorado River, and in August 1872, the expedition again started down the Colorado River at the head of Marble Gorge of the Grand Canyon and descended the Colorado River to the mouth of Kanab Canyon, at which point the party left the river and continued with topographical and geodetic surveys on land, and during December, 1872, and January, 1873 laid out the first map of the region North of the Grand Canyon in Northern Arizona and Southern Utah. He put in the topography on this map, after which it was placed in a tin tube and soldered in, and carried the map on horseback from Kanab, Utah, to

Salt Lake City in February, 1873, and then returned to the East. (R. 1515.)

In 1875 he rode overland from Salt Lake City almost to San Bernardino, California, just south of the San Bernardino Mountains by way of Kanab and the Virgin River, and in 1876 he made a second trip as far as Las Vegas, Nevada, returning again to St. George and Kanab, Utah, and was also around the Grand Canyon of the Colorado and various parts of Southern Utah and Northern Arizona.

In 1884 and 1885 he was on the South side of the Grand Canyon and traveled up from there to the Four Corners, where Utah, Colorado, Arizona, and New Mexico come together, and lived on the first mesa of the Hopis, with the Hopis for four or five weeks and spent the remainder of the winter at Keen's Canyon.

In 1903 he went down in the Zion's country north of the Grand Canyon of the Colorado River and all through that region, and in 1907 he was again on the south side of the Grand Canyon and through that region to California. (R. 1516, 1517.)

The second Powell Expedition in 1871 was headed by John Wesley Powell. It was financed by two appropriations from Congress of $10,000 each and was a Government expedition and rations were drawn from Fort Bridger, Wyoming.

They had three boats, each twenty-two feet long over all, a cabin—that is, three cabins on the boats leaving two places for the rowers; the boats have to be covered—the cabin, as you might call it, on

account of running through rapids and being full of water.

When you run through rapids they have got to float with the cargo and the men in them when they are full of water, because they are frequently filled with water.

The cabins that he refers to are not the character of cabin you sleep in; the boats were decked over with bulkheads in three compartments—making three compartments like trunks, that had hatches, and packed everything in there and battened them down so if the boat capsized we wouldn't lose the goods.

Sometimes they went over very quickly, and if things were not well secured, of course we would lose them. They did lose compasses and things like that, frequently, that were not put under the hatches. (R. 1517–1518.)

These boats drew about eighteen inches loaded and were about five feet wide. The expedition started with 2,200 pounds of flour, as at that time the only places where supplies could be obtained were at Salt Lake City, Utah, or Fort Bridger, Wyoming. "We had to take all we could." (R. 1518.) Some of the flour had to be disposed of, as the boats were too heavily loaded.

Fort Bridger, Wyoming, is located west of Green River on Blacks Fork.

The start was made with eleven men, but one proved inefficient and was sent back after about

two weeks, leaving three men to each boat not including Major Powell, who sat on the middle cabin of our boat.

Captain Francis M. Bishop, of Salt Lake City, who is eighty-seven years old, is the only other living survivor of the Powell Expedition. (R. 1518–1519.)

The boats were made in Chicago and were well constructed of one-half inch oak, double-ribbed fore and aft and very strong, as a boat has to be which goes down the Colorado. (R. 1519.)

They had rubber life preservers; they weren't very good. They were in the way when we rowed. But they were carried, a life preserver of the old sausage type, the only thing we could get at that time. To-day the men all use a newer kind, like a jacket, which buttons on. Mr. Stanton always insisted on the men wearing their life preservers every time they went on the river. (R. 1519.)

This expedition left Green River, Wyoming, May 22, 1871, and except for a few sand bars which they ran on, was easily negotiated for eighty miles. They then entered Flaming Gorge, the starting of the canyon region. The river is then canyoned for about one thousand miles with the exception of Brown's Park and the Uintah Basin. Below Flaming Gorge, Red Canyon is entered, which is about twenty-five miles long and very precipitous, the fall, he believes, being three hundred or four hundred feet in this twenty-five miles.

Lodore Canyon, one of the most difficult canyons on the river, is next. The first Powell Expedition lost a boat going through there, it being smashed at Disaster Falls. (R. 1520.)

Then comes Whirlpool Canyon, which is not so bad, but has some lively rapids in it.

Below Lodore Canyon is the Uintah Basin in Utah, where comparatively good going is had for thirty miles or so, after which comes the Canyon of Desolation, some ninety-seven or one hundred miles long and of very rapid descent; "rapids and shoal water at low water." (R. 1521.)

After Desolation Canyon is Gray Canyon, about twenty or thirty miles long, with a few rapids in it.

Next comes Gunnison Crossing, where Greenriver, Utah, is now located. (R. 1521.) Encountered no other boats. (R. 1521–1522.)

The expedition was resupplied with rations brought overland from Salt Lake City, Utah, to the Indian Agency at Uintah, Utah, at the mouth of the Duchesne River. They were not brought down on the river; they couldn't do that. (R. 1522.)

Major Powell left the expedition at Duchesne and went out to make arrangements for rations, to meet us at the mouth of the Dirty Devil River. The party that he got to bring the rations in couldn't find the river and so the expedition took on extra supplies that came in overland from Manti, Utah, to Gunnison Crossing. These supplies came in by

pack mule in charge of Major Powell himself, who came from Manti, Utah, with two men from Kanab, named Fred and Lyman Hamblin. These two men had been utilized by Major Powell on other occasions for transporting supplies and they had absolutely no knowledge of the regions nor did they own any boats. (R. 1523.) One of these Hamblins made a short trip with him; he got on the boat. They camped a little below where we met Powell; Powell came up on the west side of the river two or three miles from where he had camped to where they had camped, and one of the Hamblins came with him, and they took him on the boat to take him down to their camp, and there were some riffles in between; he was quite startled at going through this terrible water. (R. 1524.)

He then described the character of the Green River between Gunnison Crossing [Greenriver, Utah] and the mouth of the San Rafael River as he saw it in 1871. He stated that there are no rapids in that region; just swift water with riffles; that they might be called rapids elsewhere but in comparison with the rapids which he had seen above that they didn't amount to much in this particular stretch of the river. (R. 1525.) They called riffles generally where the water was simply swift, with some small waves, where the water was shallow, and your boat was apt to ground at low water. The rapids, on the other hand, were lively descents, from five or six to ten or fifteen feet in

thirty or forty yards, sometimes longer, and required a great deal of consideration and care and caution. (R. 1526.)

The expedition left Greenriver, Utah, about the middle of July, the exact date being stated correctly in his book [Compl. Exh. No. 14] and they had no serious trouble with grounding on sand bars between Greenriver, Utah, and the mouth of the San Rafael and they saw no other boats or people outside of the Hamblins.

Below the San Rafael River they come to Labyrinth Canyon and following that is Stillwater Canyon. Both of these canyons were comparatively free from rocks. They had trouble grounding in Labyrinth Canyon on the sand bars, but not in Stillwater Canyon, as the river was narrow there and they went on without much trouble. (R. 1526–1527.) The method adopted of getting off of these sand bars was to get off and wade along, sometimes waded for considerable distances, lift the boats along, ease them up. None of the party had been on first expedition except Major Powell. (R. 1527.)

He describes Stillwater Canyon as being comparatively free from obstructions and Labyrinth Canyon as being full of sand bars. The water through this section was rather under the medium stage, and no boats or people were seen between the mouth of the San Rafael and the head of Cataract Canyon [in the Colorado River]. During

this stage of the expedition they had some heavy rain storms that caused the river to vary slightly, the water coming over the canyon walls in cataracts all the way along during these storms. Just below the San Rafael they encountered very heavy rain storms, and the cascades were numerous, there being hundreds of them falling into the river, some with a fall of fifty feet and some with a fall of eight hundred or nine hundred feet. These cascades didn't have much effect on the river itself, but the continuous rains will raise the river. (R. 1528-1529.) As you turn into Cataract Canyon and run down about four miles, you meet with a very bad rapid; the fall must be ten or fifteen feet, in a few yards, and from that on down you have a very severe river.

Cataract Canyon is about forty miles long, and Narrow Canyon, below, is about ten, making about fifty miles altogether. And in one portion of the river there is a fall of about two hundred and twenty feet in twenty miles. (R. 1529.) The expedition ran some of the rapids in Cataract Canyon and made portages around others.

Did not run all the rapids in Cataract Canyon; ran some, and made portages around others; had to make a good many portages in that middle stretch of Cataract Canyon where the declivity is so great. It was necessary to line the boats very often; very often they had to line them down, and then sometimes get in them and run a little ways,

and then go on with the lining down; sometimes have to take the cargo out and carry the cargo for some yards, one hundred yards, perhaps a quarter of a mile, then load up and go on again — in various ways. (R. 1529-1530.) They did not lose any boats in Cataract Canyon, but the rapids were almost continuous. (R. 1530.) He does not remember how many rapids had to portage, but it was a great many, great many rapids, the rapids are almost continuous. Hauled the boats over the land on the banks, and also lined them. (R. 1530-1531.)

He states that everybody would make a different examination of the rapids as every stage of water makes them different. Sometimes what might be two or three rapids would merge into one large rapid at a higher stage. He stated that if Compl. Exh. 14, a book written by himself entitled "A Canyon Voyage" recites that there are sixty-two rapids in Cataract Canyon, that that would be correct.

He also recalls that there is one rapid just below the mouth of the San Juan River, but above that point, the water had been rather low, they encountered ledges running clear across the river, the boats would ground on these ledges, and they would have to get out And wade along side and lift the boats over. When he went through Glen Canyon the second time, they had no trouble with these ledges, because the water was very high but through

the Glen Canyon section there are a number of small rapids and shallows that they had trouble with. (R. 1531, 1532.) The canyons in the Colorado River were named by Major Powell. (R. 1532.)

On Page 139 of his book A Canyon Voyage, he states, "The river, some three hundred and fifty feet wide, was low, causing many shoals, which fortified the small rapids"; they often had to wade alongside to lighten the boats, otherwise these places were easy. That was near a ruin of the old Indians, up on the cliff near by, called Shinumo ruins. That was opposite the mouth of Dirty Devil River; but there were others all the way down. (R. 1532-1533.) Other ruins were seen all the way down on the walls of the river. There were storage caves in many places where they used to store corn, in sort of bins up under the cliffs. (R. 1533.) These were not the same Indians that live in the vicinity at the present time, but were a tribe called by the Piutes, "Shinumos," and were the so-called cliff dwellers. These same Indians may exist in some of the tribes to-day, as the Hopis are still cliff dwellers, and the fact that these particular Indians lived in the cliffs did not indicate that they were different from the other Indians, simply that they had chosen these places for defense. (R. 1534.).

On page 140 of The Canyon Voyage, it is recited: "The next day, October 4th, we ran into a stratum

of sandstone shale, which at this low stage of water, for about five miles gave us some trouble." (R. 1536.) It was very difficult to locate a particular point like the stratum of sandstone shale which he believes was below the mouth of Dirty Devil River some seven or eight miles. When they ran on to these ledges of shale, they had to get out of the boats and walk alongside, and as the shale dropped off suddenly at the end of these tilted ledges one would sometimes suddenly go over his head [in the water]. These obstructions occured for some miles, and the process of getting over them repeated each time. In the middle of October, 1871, when he first passed the mouth of the San Juan River, it was rather low, like the Colorado, and not more than twenty or thirty feet wide, as he recollects. (R. 1537.) The second time he passed the mouth of the San Juan River, about July 1, 1872, the Colorado River was filled from wall to wall with a terrific current which, of course, backed up more or less the water of the San Juan, which was also quite high. (R. 1537–1538.)

On the first trip they encountered no difficulty at the Crossing of the Fathers, this crossing being made possible by a shoal about one-half or three-quarters of a mile long, which the Navajos and Utes took advantage of coming down from the north or south, by wading the channel, getting on the shoal and following it. When the water was not too high, the crossing was marked by the Indians with little pyramids of rock all the way down.

The first expedition, of course, avoided the shoal because they could see right where it was. From the Crossing of the Fathers on down the Colorado River to the mouth of Paria River, that is to-day called Lees Ferry, Arizona, they encountered no difficulties and there was no settlement at Lees Ferry at that time. (R. 1538–1539.) They had known of the Crossing of the Fathers, as Escalante crossed there in 1776, and it was an historic place. Also Jacob Hamblin of Southern Utah, Indian Agent of the Mormon Church for Southern Utah, had crossed there four or five times, first in 1858, and they were, therefore, on the lookout for this crossing. Between Gunnison Crossing [Greenriver, Utah] and Lees Ferry, Arizona, the party was not resupplied until they reached the Crossing of the Fathers, as Jacob Hamblin couldn't find the mouth of the Dirty Devil River, or at least he couldn't get there, as he was on the wrong stream entirely, and they, therefore, had to run past the Dirty Devil on the rations that Powell had brought in from Manti.

They found out in the spring of 1872 when they went back into the region of the Dirty Devil River that Hamblin had been on the wrong river, the Escalante River, as they named it. (R. 1540.) Although they already knew that Hamblin had failed to get our supplies there, as he had sent an Indian runner to the Uintah Indian Agency to tell Powell he couldn't get to the designated place, both the

first and second expeditions passed the mouth of the Escalante River without discovering it. The Spanish name for the Crossing of the Fathers is "El Vado de Los Padres." (R. 1540.) When they got to the Crossing of the Fathers, they found Hamblin had succeeded in getting there with supplies and had gone on to the Hopi towns across the river at that point, leaving the supplies there in charge of a couple of prospectors. These supplies were brought in by pack mule, the only way they could be brought in. (R. 1541.) After the expedition reached Lees Ferry the first year, they waited for a while and finally went by pack mule and horseback out to Kanab, Utah, Powell having arranged to have the horses brought down to the river [Lees Ferry] across the Kaibab Plateau and down Houserock Valley. The guide who was bringing in these horses and supplies got lost on Paria Plateau and wandered around about ten days before he found a way to get down to where they were at Lees Ferry. He then went from Lees Ferry to Kanab by following the base of the Trumble Cliffs to Houserock Springs, then in a northwesterly direction over the Kaibab Plateau into Prisoner Valley, a wide valley south of Kanab, and across this valley to Eightmile Spring, then on to Kanab where our headquarters for the rest of the season were located. (R. 1541–1542.) Kanab at that time consisted of a fort, with a stockade of one-story log houses, a schoolhouse, and eight or

ten houses outside the fort. The Navajos and Piutes had been pacified and the settlers had little to fear from the Indians. There weren't more than four or five hundred people at the outside. There was a post office and a telegraph line; supplies were brought in to Kanab by wagon from Salt Lake City, and the mail was brought in by a post rider. (R. 1543.)

They encountered no boats between the junction of the Green and the Colorado Rivers and Lees Ferry, and saw no prospectors between Flaming Gorge and the Crossing of the Fathers, a distance of about nine hundred miles. Two prospectors were seen at the Crossing of the Fathers and no one else was seen between that point and Lees Ferry, Arizona. (R. 1544–1545.)

After leaving Lees Ferry, Arizona, some of them stayed at Houserock Springs about four weeks. This place is simply a spring that had been discovered some years before and was called Houserock because a couple of fellows had slept under some rocks there and marked it "Rock House Hotel." They camped there and waited for Powell to come from Salt Lake and plan the winter's work.

They arrived in Kanab about the first of November, 1871. During the remainder of that winter, they went out around the surrounding country at what they called Mt. Trumble and over on the Kaibab and all around establishing geodetic points and running base lines and triangulating from the base

line to establish a base triangulation for use in laying out the maps, recorded a lot of topography, putting in trails and things of that sort. They used pack trains for doing this work and were busy the whole winter.

At the conclusion of the winter, they returned again to the Colorado River. The first time was when they tried to find the mouth of the Dirty Devil River across country. That was a very difficult operation. They finally reached there and he brought down a boat that had been left behind the year before. (R. 1545–1546.) Upon reaching the mouth of the Dirty Devil River, they went northeasterly up through the place now called Clarkston, crossing the head of the Paria River, and went up along what was called Hogback in the Potato Valley. A Mormon Party had been up there two or three years before, and it was in Potato Valley that Jacob Hamblin got lost in attempting to supply the party at the mouth of the Dirty Devil. He followed down a river that he thought was the Dirty Devil River that proved to be the Escalante River. It was a river that they knew nothing about, so it was named the Escalante because Escalante crossed the Colorado River a few miles below at the Crossing of the Fathers. They continued on across country and got to the mouth of Dirty Devil River about June, 1872. (R. 1547.) He went along then in the neighborhood of where the present town of Escalante is located.

The country in there to the right or south is a terrible country, terrible mixture of canyons and cliffs; it is very difficult to traverse; it is easier now, because trails have been worked out. On the left is what they call Aquarius Plateau, a high plateau covered with lakes and brooks; a very beautiful country; had plenty of grass and everything for the horses, until they got to the end of that. When they got to the eastern end of Aquarius Plateau, they had to descend into this canyon region; they had a great deal of difficulty getting across that, because they misunderstood some Indians they met; they wouldn't go with them, but they gave them directions. Misunderstood the directions, and they got terribly tangled up in that maze of canyons. (R. 1547–1548.)

The distance from Lees Ferry, Arizona, to Kanab overland, is a little less than one hundred miles, and from Kanab to the mouth of the Dirty Devil River, in the way you have to go, must be one hundred and fifty or two hundred miles. (R. 1548.)

They didn't go back to Lees Ferry and go up the river in a boat, because they couldn't. It is almost impossible to go up the river in any boat. (R. 1549.) He means at that time of year with those boats. (R. 1550.)

The only other settlement in that country that he visited personally was a little place about fourteen miles west of Kanab called Johnson, where a

man named Johnson had a sort of a ranch, and about thirty-five miles westerly there was another place called Paria Settlement.

About twenty miles east of Kanab there was a place called Pipe Springs, which has since been made into a National Monument. There was no town at all at Pipe Springs, simply a fortified place built by a man named Windsor. It consisted of a double house made of strong sandstone two stories high with a court between protected by large heavy doors, and the outside of the house had nothing but loopholes. A spring was conducted in from a nearby bank underground and through the house.

On his second expedition down through Glen Canyon from the mouth of the Dirty Devil to Lees Ferry, the river was very high, and the only difficulty was in stopping. They went along beautifully on this smooth, swift current, but when they wanted to stop, it was almost impossible. There was nothing to get hold of except occasionally a bank with some bushes on it, and they almost pulled the boat under water in trying to stop. (R. 1550–1551.)

When they reached Lees Ferry on this trip, they found that Lee [John D. Lee] had come in in the meantime, built a cabin, made a farm and was irrigating a garden. The improvements consisted of one house where Lee and wife No. 18 and their family lived. He saw no boats or any other people in there at the time.

He stayed at Lees Ferry two or three weeks waiting for Major Powell to arrive, but he was so slow in getting word to them that they decided to go out to Kanab to find out what the trouble was, so he borrowed a saddle from Lee and rode to Kanab and found out about Major Powell and then returned to Lees Ferry. Major Powell eventually came to Lees Ferry and brought supplies by wagon from Kanab over a wagon trail. The supplies originally came in overland to Kanab from Salt Lake City.

The autumn of 1872 was spent in additional topographic work and in about December they went to Kanab and put up some large tents and in these tents the map was drafted that he carried to Salt Lake City in February, 1873. (R. 1553.)

In taking this map to Salt Lake City, Mr. Hiller, the photographer, accompanied him. They went by saddle horse and had one pack mule on which they carried their blankets. They went over into what is now called Long Valley. It was winter and snowing. They camped in Glendale and the next day continued on top of the divide. Neither of them had been over that particular road before and didn't know where to go. They continued down into a valley and camped there and the next morning found a ranch owned by a man named Asa, continued on down the Sevier River to Panguitch and on down to Salt Lake City.

The Sevier River is not in the Colorado River Basin; it empties into Sevier Lake, which has no

outlet. The character of the country through there is successive lines of cliffs, one above the other, culminating in the pink cliffs in the plateau at an altitude of 9,000 or 10,000 feet above sea level that forms the rim of the basin. Everything from those cliffs runs down to the Colorado River and on the other side runs to the Sevier River.

During the course of the second Major Powell Expedition, while going down the river, they frequently climbed out of the canyons to do topographical work and geological examinations. The directions from the Government called for an examination for at least twelve miles on each side of the river and these directions were carried out. (R. 1555.)

The character of the country surrounding Cataract Canyon and Glen Canyon on both sides of the river is barren; absolutely barren for miles. In fact, along on the canyon the immediate region is very rugged and barren except on the Kaibab where they have a beautiful forest. / This is practically the character of all of the country from Gunnison Crossing [Greenriver, Utah] clear down to Lees Ferry..

There is practically no vegetation along Glen Canyon and back for miles along each side. The only vegetation noticed was a few bunches of grass in some little hollow where the sand accumulates. The rock is very friable, soft rock; and every time there is a rainstorm the surface is washed off so nothing can grow. (R. 1556.)

As a young man he had experience with boats on the Niagara River, as he was brought up at Buffalo and frequently went down the Niagara as far as Grand Island, which was the limit, generally, of boating on the Niagara. It was very swift. In returning from Grand Island, it is always necessary to keep very close to the Canadian shore in order to avoid the swift current in the center of the river. He also had experience on the lake.

He has also studied the Colorado River region and the people around it ever since the first time he went out there. He lived with the Hopis for five weeks and had some of them with him at Kern Canyon.

He also studied the Navajos and the Indians around Kanab and around Trumble; studied the Piutes and embodied this knowlege in his book "North Americans of Yesterday," "which is a résumé of Indian life on the continent."

In all of his investigations of the Indians and their lives and habits, he never discovered any evidence of there having owned, possessed, or operated boats [on the Colorado, Green, or San Juan Rivers]. (R. 1556–1558.)

He has published a number of books during his lifetime, consisting of: "North Americans of Yesterday"; "Breaking the Wilderness," which describes the opening of the region west of the Missouri River; "The Romance of the Colorado River" [Compl. Exh. 13]; "A Canyon Voyage"

[Compl. Exh. 14]; "Freeman in 1849," a history of Freeman's Expedition in the West; "Life of George Armstrong Custer."

In the preparation of these books he did a great deal of research work as to the historic matters they contained, particularly those books that dealt with the Colorado River, as there had never been very much written about the river before that. He, therefore, examined a great many original sources such as Government Reports, the early Pacific Railway reports and books like Patti's Famous Story, and a lot of books of that kind; with more recent books like Chittenden and Manly's book, "Death Valley in 1849," which nobody knew about, and Manly went down the Green River as far as the Uintah Valley in 1849, thinking he could go to California that way. (R. 1559-1560.)

He also studied Castanada's Manuscript of 1598, and running down through almost everything that has been published on the southwest. He couldn't recall them all.

He knew that the purpose of the Escalante Expedition was to get to Monterey, California, and to connect up the Rio Grande with the Missions of Southern California, and the map that appears in the fore part of "The Romance of the Colorado River" [Compl. Exhibit No. 13] is the approximate location of the "Escalante Trail." (R. 1560.)

This information was obtained largely from Escalante's diary of that trip, a copy of which is in

the Congressional Library in Washington. He had a translation made himself. (R. 1561.) In his investigation of Escalante's expedition he did not find that Escalante used boats at any place. (R. 1561.)

He made an investigation from many different sources, of the highway that is known as the "Spanish Trail" and he went over a large part of the trail himself four times. As far as can be determined, the "Spanish Trail" was first laid out by William Wolfskill, who was the first man to establish a fruit farm in Los Angeles and who went over the trail in 1830. The trail was used after that annually in each direction by a caravan from Monterey to Santa Fe and from Santa Fe to Monterey, interchanging goods at different localities. Los Angeles was also a destination, Monterey being the headquarters at that time, Santa Fe, a thriving town in 1830, was the capital of New Mexico, and before that Monterey was the headquarters of the missions on the Pacific Coast. (R. 1562.)

Jedidiah Smith was the first Mormon to go through to Southern California, he believes, in 1827. He went from what is now Salt Lake City, down past Utah Lake and up the Sevier River. He crossed from the Sevier River about where Parowan, Utah, is now located, and continued over to Nevada about where the railroad [the Salt Lake Route] cuts the state line and hit the head of Meadow Valley Wash and down the Muddy River now called the Adams River.

Manly, of whom he had previously spoken, had nothing to do with the "Spanish Trail." They were trying to get to California in 1849. As he had made an attempt to go down Green River, he joined a party to go to California. He got on the Green River at what is now Green River, Wyoming, and he left the Green River in the Uintah Valley.

About 1850 Captain Gunnison was conducting an exploring expedition for the Government and arrived at Green River and crossed at what has since been called Gunnison Crossing [Greenriver, Utah]. Gunnison Crossing was the great Indian highway. All trails converged with that place because they couldn't cross the river farther down, except at the Crossing of the Fathers.

About 1825 Governor Ashley of Missouri operated in that particular neighborhood. He was a very competent man, and conducted very successful fur-trading operations. His expedition met with great success because he was so cautious and provided against contingencies. (R. 1564–1565.)

They camped in the Green River Valley, which was a great rendezvous for trappers in 1825, and Ashley conceived the idea of going down the Green River, starting at the lower end of Green River Valley just before it closes in at Flaming Gorge, building boats and going down as far as Uintah Valley.

During the second Powell Expedition they found wreckage in the canyon of Lodore which Major

Powell attributed to Ashley's Party or to one preceding it, which party preceded Manley. Major Powell found the name of this party. They had wrecked their boats and tacked their names on a tree. He copied these names and put them in his diary, but the diary was burned up. (R. 1565.)

Outside of the Manley and Ashley expeditions and party prior to the Manley expedition, there was a man named Hook from Cheyenne who tried to follow Major Powell and was wrecked in Red Canyon—drowned there, and there is the name of Julien inscribed in several places in Labyrinth Canyon, one place in Cataract Canyon, but nobody knows who he was or whether he was on the river or not. (R. 1565–1566.)

He never saw the Julien inscription himself, and has made a determined effort to find out who Julien was, without success. The date 1836 was inscribed with the word "Julien." (R. 1566.)

Compl. Ex. No. 221 (R. 1567) is a map showing Old Spanish Trail in red and route traveled by witness from Kanab to Salt Lake City in blue. This shows the "Spanish Trail" starting at Santa Fe, New Mexico, proceeding in a northwesterly direction, crossing the head waters of the San Juan River, continuing on and crossing the Colorado River at what is now Moab, Utah, thence in a northwesterly direction to Gunnison Crossing where Greenriver, Utah, is now located, then west across the Wasatch Uplift in several of the valleys

that were convenient getting through, down to about where Freemont pass is, and made its exit into the great valley beyond, continuing on down to Mountain Meadow, Utah, from there across the Beaver Dam Mountains to the Virgin River, down the Virgin, across to Las Vegas, Nevada, and from Las Vegas, Nevada, over the Mojave Country to Los Angeles, about where the railroad now runs, then on up the coast to Monterey. (R. 1567–1569.) The trail left the Virgin River about thirty-five or forty miles above the point where the Virgin empties into the Colorado. In all of his investigation of the historic data surrounding the Spanish Trail, he did not find that the Spaniards or the people working with them ever used the San Juan, the Green or the Colorado River for navigation purposes. (R. 1569.)

From about 1835 there was extensive fur trapping in and about the Green River and these furs were taken out of the country by pack train, with their ultimate objective at St. Louis, Missouri. (R. 1570.) As the country developed, they had other trails from the locality of Denver, Colorado, mainly down the Platte and Arkansas [Rivers]. He never found any evidence that the fur traders ever used the Colorado River for trade or travel by boat, except Ashley, who went down as far as the Uintah Basin on one expedition, and as far as he, Dellenbaugh, knows, the fur traders never used

the Green or the part of the Colorado then known as the Grand River for trade or travel by boat.

Cross-examination (R. Vol. 9, pp. 1571–1586):

With furs, the same as with other commodities, the seller seeks the market. (R. 1571.)

San Juan, described page 140 "A Canon Voyage." (R. 1572–73.) Width estimated. (R.1574.) From Gunnison Crossing to head of cataracts had difficulty at times locating channel; trouble with sand bars; in Labyrinth Canyon they run on sand bars every hour or so. (R. 1574–75–76–77.) Did not seem to be any deeper channel in places where river spread out. (R. 1578.)

In writing book thought only of rapids, not of sand bars because sand bars did not hurt the boats. (R. 1579.)

Page 139, Compl. Exh. 14, after Cataract Canyon the river 350 ft. wide, low, shoals, small rapids; waded and lightened boats. (R. 1580.) From foot of Cataract Canyon to past Utah-Arizona State Line, lively rapids below mouth of San Juan River, 1st trip; sand bars, 15 to 20 miles below Dirty Devil River; sandstone ledges or shoals. (R. 1581.) Water muddy. (R. 1582.)

Page 287, Compl. Exh. 13, stating the river tame, should state it to be "comparatively" tame. (R. 1578.)

Low stage of water made progress difficult.

His attention was then called to page 114 of Compl. Exh. 14, where he described the head of

Cataract Canyon and a résumé of their descent from Green River, Wyoming, and Gunnison Crossing. From Gunnison Crossing [Greenriver, Utah] to the head of the cataracts, from his point of view, there wasn't a rapid worth recording, and was easy sailing except for sand bars. (R. 1574–1575.) In this stretch of the river, they at times had difficulty in locating the channel, but no serious delay or mishap. They had considerable trouble with sand bars in Labyrinth Canyon. (R. 1576.)

He desired to change his testimony through Labyrinth Canyon as far as sand bars are concerned by changing the word "occasionally" to "frequently," as they would run on sand bars every hour or so. (R. 1577.) The sand bars offered hindrance to the extent that they would have to get out of the boat and walk alongside for perhaps a quarter of a mile. There didn't seem to be any deeper channel in these places where the river spread out so much over the bars. They would get into a deeper channel if possible, because they didn't care to drag the boats along. (R. 1578.)

When he wrote his book he wasn't thinking about sand bars; only about the rapids, for the reason that the sand bars didn't hurt the boats, they only retarded the progress of the expedition. (R. 1579.)

It would have taken considerably more water in Labyrinth Canyon to have removed the trouble

caused by the sand bars. (R. 1580.) From the foot of Cataract Canyon down past the Utah-Arizona State Line, he found lively rapids below the mouth of San Juan River on the first trip down.

He recalls sand bars existing for fifteen to twenty miles below Dirty Devil River and sandstone ledges or shoals. (R. 1581.) They picked their way down the river as well as they could through these shoals, and it is his recollection that the ledges extend all the way across the river. He couldn't tell whether these ledges were uniform in height as they were under water and the water was so muddy, and there might be a channel through the ledges. (R. 1582.) His estimate of these things, the shoals or the rapids, where they said it was easy, was with reference to the rapids above, which they had gone through, which they considered difficult; when they got into a place they didn't have difficult rapids, they called them easy.

The rapid water was all the way along above that rapid in Glen Canyon below the San Juan; there were apt to be shoals and what they called little rapids.

In stating in his book the river in Glen Canyon was tame he meant compared with what they had been experiencing it was tame. That book was not checked up the way the other book was. That was more general statements.

Had that very sharp rapid below San Juan, the only real rapid in the Glen Canyon; the others are what we would call more riffles, little rapids, shoals,

things of that sort. This real rapid is about two or three miles below the San Juan. Didn't make any portage there; ran right through it. (R. 1585–1586.)

They didn't consider this rapid below the San Juan as dangerous and below this rapid he didn't recall any obstructions or difficulties. (R. 1586.)

Redirect examination (R. Vol. 9, pp. 1587–1588):

On the second Powell Expedition, Major Powell sat on the middle cabin of our boat in an armchair that was strapped on so he could see ahead. (R. 1587.)

The photographs contained in Exhibits 13 and 14 were taken by a man named Beman, who was the photographer the first season.

He knew Robert Brewster Stanton very well in his lifetime, and Mr. Stanton was a mining engineer quite eminent in his profession.

The field notes kept by Mr. Stanton are in the Manuscript Department of the New York Public Library. He deposited them there himself, with the consent of Stanton's widow, and he is sure they are authentic. (R. 1588.)

Recross-examination (R. Vol. 9, p. 1588):

Major Powell had only one arm. (R. 1588.)

Further examination (R. Vol. 9, pp. 1589–1594):

The boats filled with water wherever there were rapids; that is apt to occur; depended on what kind

of waves you struck; just the way you happened to take a rapid. They filled with water along Red Canyon in Cataract Canyon, of course, all through there you were liable to get full of water whenever you ran a rapid. Nowhere else except at the rapid in Glen Canyon, where may have shipped a little. (R. 1589.)

He has no recollection of ever encountering any sand waves. The boats were very sturdy in their construction and they wouldn't have minded sand waves, because they could stand almost anything. There were three men in each boat, except one, which carried four, and he believes there were 1,000 to 1,200 pounds in each boat.

On his first trip down the river they left a boat at the mouth of the Dirty Devil, until the following year, because they were short of rations, and they couldn't stop long enough to make the investigations and photographs they intended to make. They left no one with the boat, simply hauled it up fifty feet above the river and filled it with sand. From this point on down to Lees Ferry, the two remaining boats were more heavily loaded, as supplies and men were all carried down on them. (R. 1591.)

When they returned the following year they found the boat all right except the water had been up and washed the sand away from under the keel. The boat was probably left not more than twenty feet above the ordinary stage of water.

He observed that access was made to the caves and storage places used by the former Indian inhabitants, overland by trails from the back country on both sides of the river; where they had their gardens on the bottom lands. (R. 1592.)

They found that there were bottom lands all through Glen Canyon. The Indians had cultivated the bottom land and raised corn, and they would come down to these farms and store their corn in the granaries in the caves.

Some of the bottom lands in Glen Canyon are perhaps a quarter of a mile long and several hundred yards wide. These signs of Indian habitation were accessible from the river. (R. 1593.)

In Stillwater Canyon, they found quite a well-preserved ruin that had evidently been an Indian lookout, and back of this there was a little bottom land, then a trail leading up the high cliffs, about twelve hundred feet high. (R. 1594.)

Recross examination (R. Vol. 9, pp. 1594–1595):

Will find the Indian ruins everywhere in the canyon; even in the Grand Canyon you will find them, where there is no bottom land; they seemed to build these granaries in the holes in the cliff in order to store their things.

He did not find them in portions of the canyon where, so far as he observed, there were no evidences of trails up to the rim; but of course, a good many places where they went out they cut

hand-holds and foot-holds in the cliffs; those are washed away; you can't tell where they got out.

He did not see them in places where there were no evidences, so far as he observed, of a path or other way up to the rim; there were always places where they could get out; that is his recollection; you would find these handholds, remnants of the handholds, and footholds, almost invariably where you find the ruins. There are some places where they had been partially washed away; you couldn't use them, but you would see the evidences of these handholds; sometimes you could use them, and sometimes you couldn't. (R. 1594–1595.)

Further examination (R. Vol. 9, pp. 1595–1596):

They did have a portion of some notes made by the former party, but not of that particular part of the river. This was a pioneer trip so far as maps or printed matter were concerned. Pioneer trip, in general a pioneer trip; it was the trip that gathered the data on which Powell made his report. (R. 1595–1596.)

Recalled (R. Vol. 12, pp. 2230–2233).

Further cross-examination (R. Vol. 12, pp. 2230–2233):

He looked over a few old photographs shown to him by Mr. Farnsworth, and has made notations on the backs of the copies of the photographs, indicating approximately the location of where the pictures were taken. The pictures were taken dur-

ing the second Powell expedition, and were marked and received in evidence (R. 2232), Deft's. Exhs. Nos. 5 to 10 inclusive respectively. Deft's. Exh. No. 8 is a picture of the boat named the Emma Dean. (R. 2231.)

On the backs of each of these photographs, except Deft's. Exh. No. 9, appears this notation, "U. S. Topographic and Geological Survey of the Colorado river of the West by J. W. Powell and A. H. Thompson." (R. 2232.)

On the back of Deft's. Exh. No. 9 appears the notation, "Department of the Interior, U. S. Geographical and Geological Survey of the Rocky Mountain region, J. W. Powell, geologist in charge." (R. 2232–2233.)

Recalled (R. Vol. 25, pp. 4292–4314).

He, having heretofore testified for the complainant, was recalled to the stand and testified that he prepared certain historical data in connection with the probable uses of the Colorado River in the early days by going to the Historian's Office [of the Mormon Church] in the office building of the church at Salt Lake City, and from the records, culled what he thought was necessary and had it typed. (R. 4292.)

He gives the location of the place called Callville as being a warehouse built by the Mormon Church about 1860 to 1864, for the purpose of storing goods that were brought up the Colorado River by steamer to that point, "which was considered

head of navigation," and it would then be transported by wagons to St. George [Utah] and distributed. It was considered to be a cheaper way of getting goods into the country than coming across the plains. (R. 4293.)

Callville was located seven miles east of Vegas Wash, Nevada, two or three miles below the end of Boulder Canyon. "This warehouse was constructed, but it never was used to any extent." (R. 4294.)

Compl. Exh. No. 620, which deals with the settlement of the San Juan River in and about Bluff, prepared by Mr. Dellenbaugh, offered in evidence. (R. Vol. 25, p. 4294.)

Compl. Exh. No. 621, entitled "Settlement of the Kanab Region in Southern Utah," offered in evidence. (R. Vol. 25, p. 4298.)

Compl. Exh. No. 622, "The Exploration of Southern Nevada," offered in evidence. (R. Vol. 25, p. 4299.)

Compl. Exh. No. 623, "Expedition to the Colorado River, Call's Landing," offered in evidence. (R. Vol. 25, p. 4300.)

Compl. Exh. No. 624, "Exploration of Southern Nevada, St. George Stake"; also deals with Call's Landing and Hardy's Landing, offered in evidence. (R. Vol. 25, p. 4301.)

Compl. Exh. No. 625, "The Settlement of Moab in the year 1855," offered in evidence. (R. Vol. 25, p. 4303.)

Compl. Exh. No. 626, "The Exploration of Southern Nevada, years 1855 to 1865, Las Vegas Mission," offered in evidence. (R. Vol. 25, p. 4303.)

He lived in this country [Utah and Northern Arizona] in 1871 and was in Southern Utah two years at that time, also in 1875 and 1876. (R. 4303–4304.)

He wasn't connected with the paper [Deseret News] and wasn't a member of the [Mormon] Church.

As far as he knows, the Deseret News was the organ of the Mormon Church, and whenever any exploring and settlement parties went out, they wrote back letters, generally, to the Deseret News and "when they [the Church Historians] made up their records they searched the pages of the Deseret News" and the Church Historian has verified them as to the historical accuracy. (R. 4305.)

Cross-examination (R. Vol. 25, pp. 4306–4307):

The historical records were compiled from the original letters and other records. (R. 4306.)

He doesn't believe that the letters and other matters appearing in the Deseret News were caused to appear there for any other reason than communications appear in other newspapers, but that when a party went out into the outlying country, they would keep records and write letters to the paper, and the communications he has copied from the

Desert News were merely letters that had been written in to that newspaper. (R. 4307.)

Redirect-examination (R. Vol. 25, pp. 4308–4313):

The documents which he has prepared were found in the office of the Historian [of the Mormon Church] which maintains an historical department. (R. 4308.)

Compl. Exh. No. 176, Diary and Field Notes of Robert Brewster Stanton, of his two expeditions on the Colorado River, offered in evidence. (R. Vol. 25, pp. 4308–4310.)

Compl. Exh. No. 627, Diary of Almond H. Thompson, Chief Geographer of the Second Powell Expedition, offered in evidence. (R. Vol. 25, pp. 4309–4311.)

Compl. Exh. No. 628, Diary of S. V. Jones, one of the topographers of the Second Powell Expedition, offered in evidence. (R. Vol. 25, p. 4311.)

The diary of Almond H. Thompson was bequeathed to him [Dellenbaugh] and he presented it to the New York Public Library. The diary of S. V. Jones was presented to the New York Public Library at his [Dellenbaugh] suggestion. (R. 4311.)

Compl. Exh. No. 629, the Diary of Capt. Bishop one of the topographers of the Second Powell Expedition, offered in evidence. (R. Vol. 25, p. 4312.)

Capt. Bishop was on the second Powell Expedition down as far as Lees Ferry and the original of

the diary is in the hands of the New York Public Library, but it doesn't belong there as it belongs to Capt. Bishop who lives in Salt Lake City. He [Dellenbaugh] took the diary to the New York Public Library himself. (R. 4312.)

The Stanton Field Notes were presented to the New York Public Library at the suggestion of Mr. Dellenbaugh. (R. 4313.)

Further examination (R. Vol. 25, p. 4313):

All these documents have been in the New York Public Library long before this suit was initiated, except this second half of the Bishop diary. (R. 4313.)

Recross-examination (R. Vol. 25, pp. 4313–4314):

In selecting these excerpts that are reproduced in Complainant Exhibits 620 to 626, he sought to cover the field of settlement, the travel and settlement into these various regions, that was all. And he selected those things that in his opinion had a bearing upon the matter of settlement. (R. 4313–4314.)

JOHN WETHERILL

For Complainant

(Record, vol. 9, pp. 1597–1652)

He resides at Kayenta, Arizona, by occupation is a guide in the San Juan Country of Colorado, New Mexico, Arizona, and Utah, and is familiar with the San Juan Country, from Pagosa Springs to the junction of the San Juan River with the Colorado River. (R. 1597–1598.)

He has seen boats on the San Juan River, skiffs usually, used for crossing the river, and has seen two small skiffs carrying men who were prospectors or something like that; one from Fruitland, New Mexico, to Bluff, and the other went below Bluff prospecting. He just happened to be there on the river at Mexican Hat and saw them come in. That was about in 1898. (R. 1598.)

He has seen the San Juan River many times since 1881, and has run cattle in and around the San Juan River, crossing the river at Goodrich, Utah, also called Mexican Hat, although Mexican Hat proper is about two and a half miles from Goodrich.

He has also done some prospecting at the mouth of Johns Canyon, about fifty miles below Bluff on the San Juan River, and took in his supplies overland by pack animals. (R. 1599.)

He never brought any supplies in by boats and never saw any other prospectors down there using boats. All got their supplies in by teams or pack train.

He also recalls an occasion in 1902 or 1903 when he crossed the San Juan River about eight miles above Farmington, New Mexico, when it was dry. (R. 1600.)

Between Farmington and the mouth of the San Juan there are no streams that have a regular flow of water. The Mancos, the La Plata, and the Animus Rivers were all dry. (R. 1601.)

He has also crossed the river below Bluff and at the crossing by the mouth of the Mancos that is up above the mouth of the Animus, without getting his knees wet; also at Mexican Hat, at the mouth of Comb Wash, the Barton Cabin, about eight miles below Comb Wash, and also at a place called Sand Crossing three or four miles below there. (R. 1601–1602.)

He has been an Indian trader and kept a store at Ojoalamo, Chavis, Benito, New Mexico, and Oljato and Kyenta, Arizona, and as long as he has been in that country he has never seen any of the merchants in and around Bluff, Mexican Hat, or any other points in the San Juan River, use the San Juan River for the purpose of bringing in merchandise. (R. 1602.)

For years the merchants brought their supplies in by team from Mancos, Colorado, and afterwards they came in by the way of Monticello and Blanding, Utah, from Salt Lake City, Utah.

He knows that there has been considerable wool raised in San Juan Country [Utah] and he knows that the wool and other things that are raised in that country are shipped out by team. (R. 1603.)

He is also familiar with the Colorado River in the vicinity of Vasey Trail, about twenty-five miles below the Bright Angel Trail, and then on up the Colorado to the junction of the Grand [Colorado] and the Green River. (R. 1603.)

He has never been on the Colorado River in a boat, except to put stock across the river, has only

been along the banks and his purpose of going down into the Colorado River was acting as guide and taking parties, usually from the East, who wanted to see the country. He would pick up these parties at the Grand Canyon, Tuba City, Arizona, Mancos, Colorado, sometimes at Bluff, Utah, Gallup, New Mexico, or Flagstaff, Arizona. The last party he took through was from Blanding, and he went along the Colorado River for fifty or sixty miles in May and June [1929] covering the Colorado River from the mouth of the San Juan River to White Canyon, following the rim of the river on the southeast. (R. 1603–1605.)

He took this party down from White Canyon to the mouth of the San Juan River and he has taken them down into the Canyon itself. There are only certain places where he could get down, but when he would come to these places, they would go down to the river, but the general travel was on the rim anywhere from five hundred to two thousand feet above the river. (R. 1605.)

He could get down to the river near the Crossing of the Fathers, at that point the rim being only about one hundred feet above the river. There are many places you can get down where the Indians had been crossing, and above that is the mouth of the Rainbow Bridge Canyon, but the only place above there you can get down is at the mouth of Bridge Canyon, it being necessary to go around about thirty-five miles to get from one trail to the other.

He would take his pack and saddle stock with the party that he would have down to the river, where he could get a boat, swim the stock, cross the river and go on the other side. (R. 1606.)

The places he usually crossed were at Lees Ferry, the mouth of Red Canyon and Hite.

Hite is also known as Dandy Crossing, the actual crossing being about eight miles above, or five miles above where White Canyon comes in, and is where the old Dandy Ferry used to be. This ferry was there from 1879 to 1881 or 1882, and was first used by an outlaw band that was in there, and then he believes the Mormons used it in crossing into Bluff in 1880. He never used this Ferry himself. (R. 1607.)

When he crossed at Hite he used a boat that might be owned by different people who would be in there at the time, sometimes one person and sometimes another. He recalls a boat owner by the name of Humphreys, and another, John Hite. Whoever happened to be there would own a boat and they crossed in it. (R. 1608.)

He never spent very much time in and around Hite and never received any mail at the Hite Post Office. (R. 1608.)

He has observed the sand in the San Juan River and knows that it shifts a great deal. He has crossed it when the water would be four feet deep on one side and the channel would be all on one side; coming back in three or four days, it would

be just the reverse and impossible to cross on account of quicksand. This particular point was called Clay Hill Crossing, and that is located about seventy-five miles below Bluff, about forty miles below the mouth of Chinle Creek, it may be marked on the map as Recompense Camp or Piute Farms. (R. 1609–1610.)

He has observed that the San Juan River carries a lot of sand and sediment, and at what is called Johns Camp, has observed that the bed of the river has raised ten feet in the last few years and the sand shifts from one side to the other. The bottoms will be taken out and put right on the other side, whole masses of sand at a time.

The summer storms are usually what caused the shifting of the bottoms from one side of the river to the other, and during these storms, the river runs very heavy in mud.

The different streams bring in different kinds of mud that will be deposited in one place, which causes the different colorings in the different sands. (R. 1610.)

The San Juan River is canyoned up from Bluff, except where it breaks through a ridge of mountains and leaves an opening, and these canyons are dropping off more or less all the time, and when they drop into the river it leaves a mass of rock that has to be washed away creating almost an impassable barrier at times. There are rapids at the mouth of Piute Canyon. (R. 1611.)

In 1915, as he recalls, he saw a man named Turner on the Colorado River with a twenty-four foot motor boat, equipped also with a sail to help him back up the river. (R. 1611.)

Turner had some placer claims at the mouth of Red Canyon and he saw him operate the boat down the river. He had a sail on it, but wasn't using it when he went down the river. He was never in the boat himself.

The other boats he saw were just small skiffs and were used, as most of the boats on the river were used, simply to cross back and forth at high water. (R. 1612.)

The traders along the river have boats that they use to carry the Indians' wool across the river.

He has had considerable experience with the Navajo Indians, has lived with them, has been on the reservation for the past thirty years, but does not know of any of the Navajo Indians having owned or used boats except to cross the river with their wool in boats owned by the traders. (R. 1613.)

He is familiar with the roads and trails in that particular part of San Juan Country that lie west of a line drawn north and south through Bluff, Utah, and has been in the locality recently. (R. 1614.)

He is also familiar with a road that goes from Bluff to Mexican Hat and on to Lees Ferry, Flagstaff, and Grand Canyon. This road is on the

south side of the San Juan River from Goodrich, where the road crosses the river. Sometimes automobiles travel on this road on the north side of the river west of Mexican Hat.

The nearest road in there west of Mexican Hat on north side of the San Juan is from Blanding to the Armstrong canyon, Edwin bridge on the White canyon. The next one north is about twenty-five miles north from Bluff to Blanding. Then from Blanding to the end of the road is forty-eight miles across the top of the Elk mountains. This road ends at the Edwin Natural Bridge, located a little southeast from what they call the Bear's Ears, the highest point on Elk Mountains. (R. 1614–1615.)

In 1880 there was a road from the Colorado River to Bluff, put in from White Canyon, around the head of Grand Gulch, struck Comb Wash about twelve miles above the river, went to the river [San Juan] and on to Bluff, cutting through the cliff, but it is impassable. There is also a trail that goes from Marsh Pass, crosses at the Recompense Placer Mines, the Clay Hill Crossing, and on to Elk Mountains. From that trail you can go down to the Hall Crossing, Hole-in-the-Rock, or Hite on the Colorado River. Another trail crosses the San Juan River three miles up from its mouth, crosses over to the Hole-in-the-Rock and on into Escalante, Utah. Another trail crosses at the mouth of Piute, out over the Grey mesa and covers the Hall Crossing and Hole-in-the-Rock. The Recompense trail

covers all three points, Hole-in-the-Rock, Hall's crossing, and Hite. (R. 1616.) There is another crossing of the San Juan at Goodrich, where the road crosses that cuts out through rough country. This road covers all these other trails. Another one goes up Comb Wash, up Road Canyon, over the old Mormon Road, around Grand Gulch, and into the White Canyon Natural Bridge. (R. 1617.)

When he took the party down from Blanding to the Colorado river he got to the Colorado river by going down over the clay hills, down the Castle wash, across to Lake Canyon, from there over to Rimrock Canyon, then down the Colorado along its rim to the south of the San Juan, struck it at Rimrock Canyon, which is not marked on the map.

There is no road or trail leading along the San Juan river all the way from Bluff to the Colorado river; it is impossible to get down through there; you would have to wade part of the way if you got through afoot.

Party he guided from Blanding went down over the clay hills, down Castle Wash, across to Lake Canyon, over to Rimrock Canyon, down Colorado along rim to south of San Juan. No road or trail along San Juan from Bluff to Colorado; impossible; would have to wade part of way to get through afoot. To go from Bluff to junction of Colorado and San Juan would be down old Mormon road to Hole-in-the-Rock, and down the rim on the Colorado. Only way to go by pack animal or horseback. (R. 1617–1618–19.) Trail built by Hona-

kers, placer mining on San Juan; 8 or 9 miles below Mexican Hat, extends from rim down to river. (R. 1619.)

If he wanted to get from Bluff to the junction of the Colorado and the San Juan rivers, how would you get there by land. The only possible way would be, as I told you, down the Colorado or down the old Mormon road to Hole-in-the-Wall and down the rim, then you can get down about one hundred feet above the river, or get down to the river if you want to go there.

If he wanted to go from Bluff to the junction of the Colorado and San Juan rivers on land, he would go over the old Mormon road down to the Hole-in-the-Wall on the Colorado; that takes you across the Grand gulch; that heads in Grand gulch. There is one that cuts through Grand gulch, but not often used, because people are not acquainted with the country. If he was going, he would take the one that crosses Grand gulch, and go to the Hole-in-the-Wall, on the Colorado, and then climb up on the rim before you get to the river, follow the rim around until you got about seven or eight miles—about seven miles from the Cottonwood canyon to the forks of the river, following the rim; that is the only possible way to get anywhere near the forks of the river with a horse or pack animal. (R. 1617–1619.)

He is familiar with the Honaker Trail. This trail was built by the Honakers, who were placer

mining on the San Juan River. It starts about eight or nine miles below Mexican Hat, and extends from the rim down to the San Juan River. (R. 1619.)

He also knows the Mendenhall Trail which is located between Honaker Trail and Mexican Hat. He has been over this trail down over what they call the Goosenecks. (R. 1619–1620.)

In the country west of Bluff there are no settlers or ranchers except over in the Moonlight District, near the Monument Valley, where there are five or six ranchers who have trading stores and small bunches of sheep. This district is located about eighteen miles south of the San Juan River. There have never been any other ranchers in this locality or any other settlers, except the oil men in and around Goodfich and the placer miners along the river.

There is a trading store at Goodrich, but the land on which it is located is owned by some [oil company] and not by the operators of the store.

He is also familiar with the country between the San Juan River and the Colorado River and has been on one trip from Bluff to Greenriver [Utah] in 1910. That was his first trip through there. (R. 1620–1621.)

Cross-examination (R. Vol. 9, pp. 1621–1645):

If he desired to go from Bluff to the Colorado he wouldn't travel close to the river. The roads

would be very winding roads avoiding difficulties in the topography of the country.

He was born in Leavenworth, Kansas, and moved to Mancos, Colorado, when he was fourteen years old. (R. 1621.)

He resided in Mancos until 1900 or until he was approximately thirty-four years old and during that time he was in Utah occasionally, working in the ruins along the San Juan River for the Chicago World's Fair during the winters of 1892, 1893, and 1894. These ruins were located up Chinle Wash in White Canyon, Nokai Canyon, and McElmo, and there are also ruins right along the San Juan River near Bluff that he has also worked in. (R. 1622.) These ruins along the San Juan River extend from the mouth of the San Juan up the river as far as you want to go. He worked on these ruins during the year they were working near Bluff and in Grand Gulch. (R. 1622.) Grand Gulch is located below Bluff about forty miles to the point where they would go down to the Gulch. These expeditions were made by pack train.

In 1894 and 1895 he was on the lower McElmo and Montezuma Creek in Utah. (R. 1623.) McElmo is the first stream of any size that comes into the San Juan below the Mancos about twenty-five miles up the river above Bluff. Montezuma comes into the San Juan River about fifteen miles above Bluff.

He has been back and forth through Utah so many times he doesn't remember the exact dates, but he knows he was in there prospecting in 1900 and 1902; also knows he was in there in 1898 at Bluff and Mexican Hat. (R. 1623–1624.) When he was in the locality in 1898 he had stock in below what they called John's Canyon. They wintered stock in there and he was down there gathering up the remnants of the bunch. Following that expedition he was in there again in 1900 with Hrdlicki from the American Museum. Went in to get plaster cast measurements of the Piute Indians.

He went in to Bluff and out to Allen Canyon that lies north of Bluff, and he crossed the San Juan River four or five times before that above Bluff in the Farmington Country, between Benito and Farmington, New Mexico. (R. 1625.) He didn't cross the river when he was in with Hrdlicki below Bluff, but crossed the river with him at Farmington, New Mexico. In the fall of the same year he was back in the locality prospecting, looking for a lost mine that was called the Mitchell and Merrick Mine. He crossed the San Juan River at the mouth of Lamb Wash and went through to the Oljato District and up to Nokai. He just looked for the mine in one place, on Adnigii Creek. (R. 1626.) On this trip when he was looking for the lost mine, he was down on the San Juan River at the mouth of Copper Canyon and the mouth of Chinle Creek. (R. 1627.) He crossed the San

Juan River at Mules Ears, crossing at the mouth of Chinle Creek, and stayed overnight on the bank of the river. On this trip he was accompanied by his father-in-law. (R. 1628.) In 1902 he came down the San Juan River from Anarth at the mouth of McElmo, on down to Bluff, Utah, continued on down the river and crossed at the Mules Ears. This was on a prospecting trip and they followed pretty close to the river all the way down. (R. 1629.) Sometimes—one or two places had to hold the wagon—our buggy—onto the grade to keep from tipping over into the river, for stretches of a couple hundred yards. Most of the time were in sight of the river. Were where he could see some part of the river; right along the river bed, except where it was up on a little grade on the side. Crossed the river. (R. 1629.)

The ford at the Mules Ears Crossing is washed out at the present time. You can't get across with a wagon. On this trip he was accompanied by his father-in-law, his brother, and two other men by the name of Clark and Frank Lime.

They had some pack stock with them, and his brother and two of the others were riding horseback. (R. 1630.) His father-in-law and himself drove through the river in their buggy and on that trip they crossed over and back.

The next occasion that he was in Utah was in 1906, when he came down the San Juan River from Anarth, and went on down below Bluff and crossed

the river again at Mules Ears, went on out to Oljato and put in a stock of goods to trade with the Navajo Indians. (R. 1631.) This trading post was about eighteen miles south of San Juan River and he arrived there on the 17th of March, 1906, and left there in December, 1910. During the time he ran this trading post, he got his supplies from Mancos and Durango, Colorado, and some from Gallup, New Mexico. He had timber hauled for a house. He didn't do the hauling himself, but had a man driving a team. He was there numerous times along the San Juan River and had occasion at intervals to cross the river at the mouth of Copper Canyon where you can go right along by it. He had been there a number of times. Above this point for several miles, the river is canyoned up and comes out at Clay Hill Crossing. It again closes up and doesn't open up until you get to Goodrich close to Narrow Canyon. (R. 1633.) By taking detours around the head of the canyons he could get fairly close to the San Juan River, and where he would strike river would be about seventy-five to one hundred feet above the cliff. He could get down to the river at Nokai by going afoot, and at John's Camp below you can drive down to the banks of the river with a team. (R. 1633-1634.) He has been at these points twenty-five or thirty times, but his only actual contact with the river itself was in making the crossing back and forth.

(R. 1634.) He saw the Turner boat at the Adam's cabin where Turner was then living, located at the mouth of Red Canyon about eight miles below White Canyon on the Colorado River. (R. 1635.) Turner had a ranch at this point. He didn't take any trips on the river with Turner except to take his stock across. At the time he was at the Turner ranch he was accompanied by Ernest Smith and had two saddle horses and two pack animals. (R. 1636.) They rode in the boat across the Colorado River, led their saddle horses back of their boat and the mules followed behind the saddle stock. The boat they crossed in was just a little skiff, a flat bottom boat, just made for crossing the river. (R. 1637.)

He didn't cross the river in a power boat. On the other trips mentioned where he crossed the San Juan from one side to the other, there were no boats at the fords. The boats they had seen for crossing the San Juan River were located at the Four Corners, at Anarth, and at the mouth of Montezuma Creek, but these boats usually went out with the high water. Sometimes during the summer, the boat would go right down the river and they would have to make another one the following year. (R. 1638.)

Two instances he saw men going down the river in boats; one about twenty-five miles above Bluff and the other at Goodrich below Bluff. The first instance, the boat he saw going down was a flat-

bottom skiff, pointed at one end, square at the other, about twelve feet long and three feet wide. One man was in the boat with a roll of bedding and a little camp outfit. He took it for granted he had some food as the man was a prospector. (R. 1640.) The second time he saw a man going down the river, the boat was a little larger. He believes fourteen feet long and four and one-half feet or five feet wide. He saw nothing in this boat from where he stood, as he was about one-hundred-fifty feet away. The boat wasn't going down the river; it was stuck on a sand bar about fifteen miles above Bluff. (R. 1641–1642.) He saw the first of these two men about 1898, and the second in about 1909. (R. 1642.) At this time, the road down the San Juan from New Mexico to Bluff was in existence. This road came down Maneos, Colorado, on down to Bluff right along by the San Juan River. Afterwards this road was washed out. (R. 1643.) The road from Bluff down toward the Colorado River was also in existence at that time, but it was impassable except for stock. He went over the end of it that carried him south of Comb Wash to the mouth of Chinle Creek, but he had to build it up to get through. At that time there was no road to Goodrich, and the road that crossed from the north to the south side of the river crossed at Chinle Creek. (R. 1644.) This was in the years of 1898 and 1909.

The last man that went over this road had to build it up. You could get over it by building it up each trip. (R. 1645.)

Redirect examination (R. Vol. 9, pp. 1645–1648):

At the time he crossed the Colorado River with Turner [at the mouth of Red Canyon] the stock all swam through the deeper channel. None of the stock was crossed in any boat. (R. 1645–1646.)

Along the San Juan River the stretches where he could travel near the river were at the Recompense Camp, Clay Hill Crossing, at the mouth of the San Juan River and Nokai Canyon, and these stretches of two or three miles include all the places along the river in the canyon where you can go, and he couldn't stay right along the bank all the time even in those two or three miles. (R. 1646.)

The trail near Nokai Canyon is from one-half to three-quarters of a mile back from the river for about two miles of its length, and at Zahn's Camp there is a mile and a half that you can work back and forth along until you get into the canyon below. You can't follow the river direct—that is, not along the bank of the river itself. Up around Recompense there is a little canyon coming in that you have to work back and forth around. You can only get to the river itself in a few spots through there.

In 1906 there were cornfields at what he called the Piute cornfields that were swept out by the floods of 1911. (R. 1646–1647.)

He estimates that Turner had a ranch of about seventy acres at the mouth of Red Canyon on the Colorado River. (R. 1647.)

Further examination (R. Vol. 9, pp. 1648–1650):

There was a ferry near Hite, opposite White Canyon. That was a recognized crossing in the '80's, early '80's. Hite is the Dandy crossing. They had a boat to take people across. The old piers stand there now, on the one side.

The next crossing, where you get across with light boats was Red Canyon, where the Turner ranch was.

And coming down the river from Red Canyon, where the next recognized crossing was Hall's crossing, about twenty miles below. That is at Hall's Creek.

The next recognized crossing was called the Hole-in-the-Wall.

So that between Hite and the junction of the San Juan river there were five recognized crossings, the four named and the Crossing of the Fathers. That is below the junction of the San Juan river.

And to each of those crossings there was some kind of trail or road to get to them.

The purpose of persons using these crossings other than getting to the other side was, the Mormons were working in there on the Hall crossing and the Hole-in-the-Wall, to get into the Bluff

City country; they built the road around Grand gulch and into Bluff City; the Hall crossing and the Hole-in-the-Wall, the roads came together at about twenty miles out from the river. (R. 1648-1650.)

Redirect examination (R. Vol. 9, pp. 1650-1651):

The Star Ranch is a little ranch lying in the valley between the points of the Henry Mountains and was used by the outlaws in the '80's. They would cross [the Colorado River] at Hite and up Trachyte Creek into the ranch. They were simply hiding out there. (R. 1650-1651.)

At all these places which he has designated as crossing, it is possible at all these places to go down on one side of the river and get out on the other. (R. 1651.)

Recross-examination (R. Vol. 9, pp. 1651-1652):

It is about one hundred ten miles from Hite to Bluff by the road, about one hundred thirty miles from Hall crossing to Bluff by the road and about the same distance from Hole-in-the-Rock to Bluff. (R. 1651, 1652.)

WINSLOW WETHERILL

(Record Vol. 9, pp. 1652-1657)

Born July 31, 1871; resides Farmington, N. M. Familiar with country from Bluff up to Farmington, N. M. (R. 1653.)

Has been trapping for beaver along river bank from both above and below Moonlight Creek; waded up and down setting traps; been down to 60 to 75 miles below Bluff; been to foot of Navajo Mountains with pack outfit from Mancos, Colorado; ran cattle in San Juan country. Year 1904 river had lots of water in it, but could wade it most anywhere. (R. 1655.)

During summer of 1900 or 1901 saw river near Farmington, N. M., absolutely dry. (R. 1658.)

During his experience has never seen any boats with exception of ferry boats. (R. 1656.)

Has seen sand waves in vicinity of Farmington. Has observed quicksand in crossing the river. (R. 1657.)

Cross-examination:

Had a store in Farmington, N. M., and in 1900 and 1901 had a store forty miles south and east of Farmington. Hauled goods from Farmington and Gallup, N. M. (R. 1658.)

Redirect examination:

During the time he operated trading store never brought supplies in on river; used river to ferry wagon and team across, mostly forded it. (R. 1660.)

LOUISA WADE WETHERILL

For Complainant.

(Record Vol. 9, pgs. 1661-1677.)

She lives at Kayenta, Arizona, is the wife of John Wetherill, her parents came from Nevada and Col-

orado, crossed the San Juan River in 1880 and first settled at Mancos, Colorado. She is pretty familiar with the San Juan River from Farmington, New Mexico, to Bluff, Utah. (R. 1661.)

She has been down the San Juan River as far as Navajo Mountain five or six times; the last time she went into Navajo Mountain she went by car, the other times she went horseback with a pack outfit.

Her first trip to Navajo Mountain was made in about 1910 and on this trip it wasn't necessary to cross the San Juan River. She went down to Nokai Canyon, along the San Juan River on the south side from Oljato to Navajo Mountain. During this trip the river was frequently in sight; not all the time. She left the river at what is called the Corkscrew and didn't see it any more until she got back to that same point again. (R. 1662.)

She has never seen any boats on the San Juan River, except just to cross in. She has crossed at Bloomfield, at what is called Mexican Crossing, at Farmington and Shiprock, New Mexico, six miles and fifteen miles below Shiprock, at the mouth of Montezuma Creek, six miles below Bluff at the mouth of Butler Wash, at Comb Wash, at Goodrich and at the Clay Hill crossing. (R. 1663.)

The only place she has crossed the river in boats has been at Bloomfield, at the mouth of Comb Wash and the mouth of Montezuma Creek.

There is a ferry at Bloomfield that is located up above Farmington, New Mexico, and when she crossed at the mouth of Montezuma Creek it was

in a boat belonging to a trader there. The crossing she made at the mouth of Comb Wash was in a boat they made themselves. They went there one night with a lot of freight and couldn't cross the river; took lumber along, built a boat that night, and crossed next morning; loaded the goods in wagon on boat and swam the horses. (R. 1664.)

At other places she crossed the San Juan River on horseback or with teams; just drove across. At Goodrich she has crossed the river on the bridge and in a bucket on the cable.

She has never crossed the river on foot but has driven a team across when there wasn't a drop of water in it, and her children crossed on foot. She has waded the river at the mouth of Comb Wash. (R. 1665.) That was about six miles above Farmington.

The stream which flows all the year around below Farmington is the Animus, but that time the Animus was dry. She crossed the La Plata, and it was dry all the way up. (R. 1665.) It was in 1902 when the river dried up, and she does not recall any other year when it has been dry. She has seen it real low, until just a little stream of water, maybe three feet wide and six inches deep, would be running. (R. 1666.) She has seen this condition at several places both above Farmington and between Shiprock and Bluff. She doesn't recall how many different years that has occurred. (R. 1666–1667.)

For twenty-nine years she has had considerable contact with the Navajo Indians, has made a study of their lives and habits, and during all of that time she has never seen the Indians use boats to travel on the river. (R. 1667-1668.)

Cross-examination (R. Vol. 9, pp. 1668-1673):

The year following the one when the river was dry, she saw it at Bloomfield and about six miles below Shiprock, where it was only three or four feet wide. (R. 1668-1669.) It was very low; then the next year she crossed it again, it was very low. (R. 1669.)

She believes that during the low water the channel wasn't over three or four feet wide and not over a foot deep; she doesn't think it was as much as fourteen inches deep, and the time it was completely dry and this low stage, was the lowest she has ever seen the San Juan river. (R. 1670.) When it was dry, it was absolutely dry, just as dry as the floor, and the other time when she saw it extremely low, the only place there was any water was right in the middle of the stream, the river bed, and it was three or four feet wide and the only other water in the river bed was perhaps a few little pools standing around. (R. 1671.) Those low stages of the river were in 1937 and 1941. The time she saw the river very low, about a foot deep in the channel, was above Farmington, New Mexico, not below. She knows that down below Farm-

ington, the Animas flows into the San Juan, also the La Plata and the Mancos.

The Animas is the biggest tributary of the San Juan that she knows of, and when she was there, there wasn't a lot of water taken out for irrigation at and above Farmington on the San Juan river. (R. 1772.) They used the Animas River for irrigation up there, but very little water was taken out of the San Juan River.

Pine river and Piedra empties into the Animas. They don't empty into the San Juan. (R. 1673.)

CLINTON NEAL COTTON

For Complainant.

(Record Vol. 8, pp. 1674-1677.)

He lives at Gallup, New Mexico, is over seventy years old, has lived at Gallup nearly forty years, and lived ten years on the reservation at Genavo.

The sections of the San Juan River with which he is familiar are from Shiprock to Blanco. He has driven by it and has seen that section of the river off and on during the past fifteen years. (R. 1674-1675.)

Prior to that time he hadn't seen any part of the San Juan River, as there was a very bad road there then, it was hard traveling, and very few people came in from the San Juan River. Some came in with apples and other produce, loaded up with merchandise to take back to the San Juan Country. There had been a trading post established on the reservation in about 1877; he went there in about

1884 or 1885 and got his supplies, which came in overland from Albuquerque, New Mexico. The trading post was probably seventy miles from the San Juan River. After that supplies came in to Gallup or Manulite, located twenty-two miles west of Gallup.

After he was on the reservation for ten years he went to Gallup, established a wholesale house, put in supplies and furnished the people that lived on the reservation. (R. 1675–1676.)

In his knowledge the Navajo Indians, during that time, never had boats. He had heard talk of a ferry boat at Lees Ferry. He knew the Navajo Indians, knew their chiefs and something of their customs, and spoke their language fairly well.

He saw only one boat, which would probably hold two people, out on the bank at Shiprock. This was right after a big flood in that country and it was necessary for them at that time to go back to Farmington to cross the river in order to get over to Pueblo Benito. (R. 1677.)

Cross-examination (R. Vol. 9, pp. 1677):

Blanco is about fifty miles upstream from Shiprock, New Mexico.

ERNEST B. HYDE

For Complainant

(Record Vol. 9, pp. 1678–1705)

He is 64 years old; born in Salt Lake City; located at Long Beach, California. Most of life spent on or near San Juan River. (R. 1678.)

When 14 years old, in 1880, went by team and wagon from Salt Lake City to Escalante; across Escalante Desert to Colorado River; crossed in a flat boat some 30 ft. long, at Hole-in-the-Rock; man named Hall running ferry at that place. (R. 1679.) Father, mother, and family; had six wagons and teams; ferried stock across river on boat; continued through Bluff to mouth of Montezuma Canyon. (R. 1680.) A kind of a road through they patched up as they went along. Father opened trading post two miles up San Juan from Montezuma Creek. Resided there 2½ yrs. River cut cultivated bottom lands away and washed it down the river. Moved to mouth of Comb Wash. (R. 1681.)

Merchandise in store was hauled from Alamosa, Colorado; railroad later went to Durango, Colorado, and several trips were made for goods; trips to Santa Fe, N. M. Small stock from Salt Lake City. (R. 1682.)

Father never received any good by way of boats on San Juan River, nor shipped anything out by boat. Later supplies came from Thompson.

Believes Moab established about 1890; merchants received supplies from Thompson Springs, Utah, and from Grand Junction, Colorado, overland. (R. 1693.)

Freighted for placer miners. (R. 1684.)

Freighted oil rigs, tools and supplies for oil fields near Mexican Hat after placer mining operations which were in the early nineties. Does not know

of any placer mines having been supplied by boat. (R. 1685.)

Never seen any boats except ferry boats on San Juan River. Small skiffs to ferry Indians over the river. Boat at mouth of Comb Wash; one at mouth of McElmo.

There were two oil booms, 1906 or 07, and 1910 or 1911; used team and wagon to haul freight; never used river.

Possible to get in to canyon of San Juan, at Comb Wash, where there is a crossing; river open again at Mexican Hat; possible to go down the Honaker trail. At Clay Hill Gulch; mouth of Moonlight Canyon. (R. 1687, 1688.)

Low water observed at mouth of Montezuma; Bluff; Mexican Hat; Comb Wash; mouth of Moonlight Canyon; Zahns Camp. (R. 1688.) Dry seasons, normal width 125 to 150 feet, depth from few inches to knee deep. Has crossed on horseback, or foot. (R. 1689.) Crossed from one cobble to another at mouth of Comb Wash, near mouth of Chinle Creek. Riffle, rocks little larger. Ferry at mouth of Comb Wash used in high water during June and July. (R. 1690.)

Latter part of July; rain starts river to rise; recedes during August; September heavy showers; spring of year when snows melt, river high; use ferry from latter part of May until some time in July, sometimes first of August. (R. 1690-1691.)

Electric storms pile water in river in torrents swell river two or three days; goes down again.

Ferry at Comb Wash, boat 30 ft. long, 12 ft. wide, flat bottom, ran on cable. Other ferry boats, ordinary skiffs from 12 to 14 or 16 ft. long, 5 or 6 ft. wide, flat bottom, pointed at one end. (R. 1691-1692.)

Old Mormon Trail from Bluff to Hole-in-the-Rock; One up San Juan River from Bluff to ten miles above McElmo Wash; turned to Mancos and Durango, Colorado; Another up Recapture Wash, 5 miles above Bluff through Monticello, on over to Moab; ran east of Blanding. (R. 1692-1693.)

Placer operations were in canyon between Comb Wash and Mexican Hat and down below Mexican Hat; does not think there was over 25 men at any one time. (R. 1694.)

1895, foreman for placer mining company; equipment brought in by wagon from Bluff to Moonlight Canyon; forded river at Comb Wash. (R. 1695.) Machinery for oil refinery at Goodrich, brought in from Arizona by team. (R. 1696-1697.)

In 1895 no settlers west of Bluff. Country rough and rugged sandstone desert. Country west of Bluff poor agricultural country; little patches might be dry farmed near Elk mesas. No ranchers west of Bluff; one old fellow head of Comb Wash.

Indians did not own boats or boat. (R. 1698.)

From Durango, Colorado, to store at mouth of Comb Wash, 150 miles, and it took about 15 days to make round trip.

In the country west of Bluff, Utah, there is lots of loose sand which is blown first one way then another, filling up the small side gulches; not the deep canyons but the little side gulches that run into the San Juan River. He has seen them filled practically level with sand from sand storms and then the heavy rain cuts the sand and silt out and it dumps it in the river. This filling and washing out has been going on ever since he has been familiar with the country. (R. 1699–1700.)

It sometimes gets cold enough so that ice will form on the San Juan River ten or twelve inches thick, where there is enough water to freeze it that deep; some years it will freeze a foot thick or ten inches and other years it will just run mush ice. Ice ten or twelve inches thick is unusual, as the usual occurrence is mush ice.

He has also seen ice gorges between the mouth of Lime Creek and Goodrich where it would back the water up fifteen or twenty feet high, and throw slabs of ice clear out on the banks on either side. (R. 1700.)

He has seen the San Juan River once when it was completely dry, this being between 1900 and 1902. (R. 1701.)

Cross-examination (R. Vol. 9, pp. 1701–1702):

It was in August, as he remembers, when he saw the San Juan River completely dry for possibly a couple of days. (R. 1701.)

As he recalls, he got to the Hole-in-the-Rock with his father and mother on the 24th day of July [1880].

He and his brother, Frank, are interested in a stock company in that country at the present time. He is older than his brother, Frank, by five years. (R. 1701–1702.)

Redirect examination (R. Vol. 9, pp. 1702–1703):

The oil company that he is interested in is named the "Bluff Oil Company" and they have a consolidated permit [from the Government] covering different sections.

They first had the land under the Placer Act, and after the Oil Leasing Act of 1920, the Government allowed them to consolidate in one permit; the Bluff Oil Company was then organized, and there are a number of stockholders in the company besides his brother and himself.

In recent years, he has been interested in quartz mining. (R. 1702–1703.)

Recross-examination (R. Vol. 9, pp. 1704–1705):

The permit he is interested in is a United States permit and it covers different portions of the oil field in two different townships near Mexican Hat, about thirty miles below Bluff. The permit is not in the river bed, nor in the canyon, but on the east limb of the west anticline, although one corner of it may extend down in the bed of the canyon and comes very near the river. (R. 1704–1705.)

OWEN R. CLARK

For Complainant

(Recited Vol. 9, pp. 1706-1725, Vol. 10, 1728-1758.)

Resides at Lees Ferry, Arizona; 44 years old; in U. S. Navy around water and rivers; duties generally with engines, boilers, and motor boats; mechanic, repaired and operated motor boats. (R. 1706–1707.).

Has resided Lees Ferry since August, 1922; three families besides himself living there present time.

He made one trip between Greenriver and Hermit Trail in Grand Canyon—down the Green and Colorado Rivers; several short trips around Hermit Trail and up the Colorado above Lees Ferry. He is recorder for the U. S. Geological Survey. (R. 1707.)

Left Greenriver, Utah, on November 10, 1927; La Rue in charge of party. Expedition taking moving pictures of canyon. They had six Colorado River type boats. Four of them 18 ft. over all, 5 ft. beam, 24-in. freeboard, water-tight forward and aft, open pit in center for oarsman. Two 16-ft. boats. Larger boat draft about 6 inches. Smaller boats, draft about 4 inches. Row boats, built at Long Beach, California. (R. 1708–1710.)

After first five miles, encountered difficulties going over riffles; heaviest loaded boat dragged on bottom; 2 of boats stuck on sand bars in shallow water, fifteen or twenty minutes, between Green-

river and the mouth of the San Rafael; men got out and shoved them off. (R. 1710–11.)

From the mouth of the San Rafael to the junction, trouble running sand bars. (R. 1711–1712.) Stuck several times a day and men got out and pushed boat off. (R. 1712–1713.)

In going through Cataract Canyon when come to a rapid would walk down along bank and picked out the channel; one boat went through all right, others followed at intervals of 15 minutes where safe; portaged Dark Canyon Rapid; running rapids just boatmen went with boat, party walked around; cockpit filled from six inches up to being full running rapids. (R. 1713–1715.) Two boats struck rocks and were damaged, repaired; run boats sterns first. (R. 1715–1716.)

From the cataracts down to Lees Ferry had difficulties running onto bars—gravel bars where there was shallow water; one or two boats hung up; had difficulties with whirlpools, which would catch boat and turn it; difficult to hold or get boat out of whirlpools. (R. 1717.)

Did not encounter rapids, but riffle in Glen Canyon; he calls them riffles where the water is going over shallow place, not very swift. In a rapid the water is very swift, river has a drop, full of large boulders. (R. 1718.)

Only people they met on trip from Greenriver down to Lees Ferry, some Indians at Hole-in-the-Wall on Colorado River. (R. 1719.)

The trip from Greenriver, Utah, to Lees Ferry, Arizona, took twenty or twenty-one days.

He has had quite a lot of experience in handling row boats, and in his estimation, he couldn't have taken the boat he operated back up stream from Lees Ferry alone. It "probably would have been a possible thing to do with a man that had plenty of assistance and equipment to do it with."

He would say it would have taken at least six men to have taken her back as far as the cataracts, and going up through the cataracts, the boat would have to be portaged around every rapid. (R. 1720.)

The taking of moving pictures delayed the expedition quite a bit. If it hadn't been for this they could have come through in less time. (R. 1720–1721.)

He has gone up the Colorado River above Lees Ferry in a boat at least five or six times; the first time, in July, 1926, he went upstream in a motor boat about twenty-six feet long and about a five-foot beam, drawing about eighteen inches of water, the motive power on this boat being a Ford motor taken out of an automobile and belonging to him. (R. 1721.)

He made this trip just to see if he could go up there and carried supplies that would weigh in the neighborhood of two hundred and fifty pounds. He was accompanied by Bob Marshall, carried food, a camp outfit, and extra gas, and went upstream in

the neighborhood of forty or fifty miles up past the Utah Line. (R. 1722.)

From his experience with the gauge readings at Lees Ferry, he would estimate the flow of water in the Colorado River at the time he made the trip, of being in the neighborhood of forty thousand second-feet.

He left Lees Ferry in the morning about 6.00 o'clock and didn't have any difficulties until he got about four miles above there. At that point the water was so swift he had difficulty in getting through the channel. He kept as close to the shore as possible, and the man with him had an oar to pole where the water was shallow enough to help the boat through. He estimates it took him two hours to make about one hundred fifty feet progress. (R. 1723–1724.)

After he got through this place he encountered difficulties running on sand bars, but didn't have much trouble getting the boat off, as going upstream he didn't hit them hard enough and the current would be against him so that lots of times it would wash the boat back.

It took him two and a half days to go upstream, and there were places where he would only make about a mile an hour. Other places, where he could take advantage of the eddies, he would make pretty good time.

In an eddy there is a current that goes upstream that he would take advantage of, although diffi-

culty is experienced in getting out of them, as one is liable to get in a pocket formed by a sand bar at the head of the eddy so he might have to come back downstream again to get past the point of the sand bar. In following up the eddy he would find shallow water all around the head of it, a bar between the boat and the channel, would have to drop back downstream and come up in the current. (R. Vol. 9, pp. 1724-1725.)

This was between Lees Ferry and Warm Creek.

When he got forty or fifty miles upstream to Last Chance Creek he turned around and came back, as he thought it was impossible to go farther with the equipment he had. He experienced no difficulty in coming back downstream; took it very easy and made the return journey in about six hours' running time. (R. Vol. 10, 1728-1729.)

Before he made his first trip he had secured a pilot's license for carrying passengers on the river, it being a Government license, and his boat was licensed also as he was figuring on taking tourists up to the Rainbow Bridge. (R. 1729.)

He didn't experiment any more with that boat, as his next experiment was with an outboard motor. He abandoned the hull of this first boat and it is still at Lees Ferry.

The next boat was a small boat about fourteen feet long with a four-foot beam. He equipped this boat with an outboard motor and went upstream about seven or eight miles. It didn't have enough

power and he had trouble getting on bars with it. (R. 1729–1730.) He didn't experiment with any more boats.

The engine in the first boat would develop about sixteen horsepower and had a three-blade screw propeller, but he never hauled any passengers up to Rainbow Bridge as he abandoned the enterprise; figured it was impossible, as when the river was at a high stage he found the current was so swift he couldn't develop enough power to force the boat upstream; and in low water when he had the power to go upstream the sand bars would bother him so much he couldn't make it. (R. 1731–1732.)

He has observed the sand bars in the river at Lees Ferry where he ran a ferryboat for about one and a half years, and lots of times the bars would form in half an hour or an hour's time and when he would go back across [the river] the bars would be cut out. (R. 1732.)

This prevented the ferryboat from getting in to the bank, as lots of times the bars would hold the boat as far as fifty feet out from the bank, preventing navigation across the river, requiring him to put in the boat so as to throw the water in and cut the bars out. This would hold him up anywhere from one-half to three-quarters of an hour; and sometimes they were not able to do that, but would have to go across the bar if the water was shallow enough, and at times take the boat off the cable, follow the channel up the river around the

bar and then bring it down the channel, in order to get the boat in to the bank. When they would take the boat off the cable they would handle it with lines, pull it up and let it down again. (R. 1733.)

The ferryboat had no motive power, but was swung on a cable that spanned the river and to which it was attached by two other cables.

At times, they had to have assistance in operating the ferryboat. When he ran it on the cable, it was carried across the river by the force of the current.

The ferryboat at that time belonged to the county, of which he was a salaried employee, and he operated the boat from May, 1923, until February, 1925. (R. 1733–1734.)

Some days he wouldn't make any trips across the river at all, but when he was crossing cattle in the fall, he thinks he would make as many as sixty or seventy trips a day. Ordinarily, he would make about four or five trips a day. (R. 1735.)

Cross-examination (R. Vol. 10, pp. 1735–1757):

The trips he made across the river with the ferry boat were more frequent in the fall. It was generally in October and November that he took cattle across at a low stage of water. At this stage the river is about two hundred feet wide where the ferry is. (R. 1735–1736.) The first trip he made upstream from Lees Ferry was in July of 1926, on

which trip he was accompanied by Bob Marshall. He decided they would go up the Colorado River about seventy miles to the mouth of Bridge Canyon, where the Rainbow Natural Bridge is located, but after starting they only went up about fifty miles and encountered a bad place about three miles above Lees Ferry where it was narrow and swift, and another place just before he got to Warm Creek that was narrow and swift. (R. 1737.) There were sand bars all along which also caused them trouble. He afterwards found a place just below Bridge Canyon that he believes would have been worse than either one of the places that he has mentioned. The Ford motor he had on this boat would develop about sixteen horsepower, in his opinion. As he recalls, he secured his pilot's license in May or June, 1926. (R. 1738.)

The man [Bob Marshall] who accompanied him wasn't a pay passenger. He estimates that they carried about two hundred and fifty pounds of supplies consisting of bed roll, provisions and gasoline. He doesn't know how much gasoline he had, although he had a tank that held ten or eleven gallons he believes, and had ten or fifteen gallons in a can. (R. 1739.) He doesn't recall just how much food they had along, but enough to last about a week. When he turned around to come back he had about two gallons of gasoline left, and on the up trip he didn't go to any points of interest, just looked for the easiest way to get up. (R. 1740.)

He was away from Lees Ferry three nights, as while it only took him two and a half days to go upstream, they didn't start back until the morning of the third day. He estimated that he had about two gallons of gas when he turned around to come back and used what he had on the return trip. He knew he couldn't have gone up any farther with that amount of gasoline. (R. 1741-1742.) What they were figuring on doing when they left there was go as far as could with our gas, and then when had to turn around and come back, come back with the current; didn't necessarily have to have the gas to come back on.

He made several trips upstream above Lees Ferry with an outboard motor, never any more with the boat equipped with the Ford engine. He was experimenting with the outboard motor within a radius of about six miles of Lees Ferry.

He never went down below Lees Ferry, nor did he ever take any passengers, camp outfit, or food with him on these short trips. In fact, he never left Lees Ferry with the second boat except with the intention of running up the river a little and returning to camp. (R. 1744.) He wanted to see how powerful his motor was going upstream. (R. 1745.)

He had a two-cylinder, eight horsepower, Johnson Outboard Motor in this little boat and his experience with the Ford motor and this eight horsepower motor is all of his motor-boat experience on

the Colorado River. (R. 1745.) The cable crossing the river on which he operated the ferryboat was anchored on each side of the river and was never shifted while he was operating the ferry. (R. 1745-1746.)

The cable is anchored at the same places and in the same way on each side now as it was when he began to operate the ferry. The ferry is discontinued now; a year ago last June the cable broke; but the anchorages are in the same place that they were. Never shifted. (R. 1746.) Sand bars would form that prevented the boat from getting into the bank and this happened a number of times. (R. 1747.) The boat didn't get out of repair, nor the attachment to the cable, but he had to take the boat off to get around the sand bars. This would happen in low water periods when the river was on a falling stage and that finally in the summer of 1923, a shieve broke on the cable and the boat was held in midstream so that it tipped over and finally sunk. (R. 1747-1748.)

In the falling stages the readjustment necessary to accommodate the different stages of the river was to take the boat off of the cable, follow up the channel, get around the bars, bring it down in deeper water and get a car off on the bank, and when the river would fall low enough he would go below the sand bars and fix them so you could drive a car over the sand bar. At times he could shift the boat so it would run the current in and cut the bars

out, but sometimes this couldn't be done. (R. 1749–1750.) This would happen on falling stages of the river, and on rising stages a bar would keep him from getting in close to the shore and the bars would shift at different stages of the river. He never could tell when to expect them or when not to expect them. (R. 1751.) When the river was falling it would become shallower all through. And some bar might appear that would impede the progress of the ferry, which in the higher stages would not interfere with the ferry at all; there would be bars at lower stages, and bars that would not be in that place at higher stages. (R. 1752–1753.)

In high water, as well as in low water, there would be bars formed that impede the progress of the ferry. He has seen this happen between trips when the ferry was following the cable. Sometimes it would run for two or three weeks without any adjustment or difficulties, and then at times he would have difficulties every trip. These difficulties wouldn't be regular, sometimes would occur every day or probably two or three days following each other. These bars that formed were not out in the channel but were next to the bank. (R. 1754–1755.)

When he went up the Colorado River in the boat containing the Ford engine he believes he went up about sixteen miles the first day, and eight or

ten miles the last day and twenty-four or twenty-five miles the second day. He stopped at about noon the third day. (R. 1756.)

When he considered taking tourists up the river, it was his idea that the scenery on the river and the Rainbow Bridge would be a great attraction and hoped that with proper advertising and facilities for making the trip, a large number of tourists would be attracted there. (R. 1756-1757.)

Further examination (R. Vol. 10, pp. 1758–1759):

On this trip that he came down the river from Greenriver with the party headed by LaRue, that was a commercial undertaking. The object of the trip was taking moving pictures for a commercial purpose, a picture, he believes the title of it was, "The Bride of the Colorado." Never exhibited. The pictures were taken the full length. (R. 1758.)

JULIUS F. STONE

For Complainant

(Record, vol. 10, pp. 1760–1799)

He resides at Columbus, Ohio, is seventy years old, is engaged in manufacturing and banking; is also chairman of the Board of Trustees of the Ohio State University; chairman of the Board of the Seagraves Corporation, a company engaged in the manufacture of fire equipment; and chairman of the Board of some banking institutions.

He was born in the state of Michigan, and lived there until he was thirteen years old, where he became accustomed to the handling of rowboats and canoes. He afterwards handled sloops on Lake Erie, and, to some extent, motor boats; and operated boats on rivers. He first became interested in the Colorado River after reading a copy of Major Powell's book, "The Colorado River of the West." [Compl. Exhibit No. 51.] A picture in this book, showing the wreck of a boat at Disaster Falls, in Lodore Canyon, interested him very much and he wondered if it were possible for people to go through places like that and live. His first view of the Colorado River was from the Blue Mountains in Colorado in 1878. His first close view of the Colorado was in the year 1897 or 1898, when he went from Greenriver Station, Utah, by the way of Hanksville, Utah, to a point in Glen Canyon on the Colorado River, where Mr. Stanton was engaged in locating placer mining claims. He unfortunately was interested in the Stanton enterprise, as a stockholder. (R. 1760–1762.)

He had known Mr. Stanton for several years before that time, and had become somewhat interested in the placer deposits that Stanton claimed existed in Glen Canyon. He agreed to put a litfle money in with Stanton, locate some placer claims, and see whether they could be developed. He went by rail to Greenriver, Utah, then on to Hanksville by wagon, which was hauling in supplies to the

Stanton party, and from Hanksville to the Colorado River by horseback. The country between Greenriver and Hanksville is generally desert in character, with no population. There were a few scattered people who lived around Greenriver. He doesn't recall any ranches between Greenriver and Hanksville, and at Hanksville there was one supply store and a post office. The store was owned by Charlie Gibbons, was sort of a trading post, and he believes there may have been half a dozen houses and shacks around Hanksville at that time. He was only in Hanksville this one time, as he was passing through and on his way to Hite, located on the Colorado River, in Glen Canyon. He was one day going from Greenriver to Hanksville, where he stayed overnight, and one day from Hanksville to the river. He stayed on the Colorado River six weeks or two months. (R. 1763–1764.)

At the time he was on the Colorado River Mr. Stanton had a party of men locating, filing, and surveying placer mining claims. The work was done in the name of the Hoskinini Company. He may have helped a little bit with the work but was engaged principally in getting acquainted with a region which was new to him, and was not an employee of Mr. Stanton.

At one time there were probably twenty employed by Mr. Stanton. (R. 1765.)

There were a few other prospectors farther down the river, besides Mr. Stanton and his employees,

and two people lived at Hite [Utah] or Dandy Crossing. These men were Johnny Hite and Fred Gibbons, and they had some placer claims there and up White Canyon; Cass Hite lived a little way below Hite post office by himself. There was a post office at Hite at that time, and mail was brought in by pack horses from Greenriver by the way of Hanksville.

Mr. Stanton had some boats on the river at this time, and he [Stone] was in these boats from time to time. They were used for the purpose of crossing the river with supplies and now and then to take supplies down the river to other camps which were established from place to place. (R. 1766–1767.)

Mr. Stanton had the whole of Glen Canyon practically surveyed and located for placer claims. He believes that one boat was brought up from Lees Ferry by a party of Mr. Stanton's employees, and when they would take supplies downstream they would bring back the empty boats by means of oars in stretches of quiescent water, and in other places they would tow them with a tow line from the bank, or in shallow places by wading in the river. At this time he saw boats handled in this way twenty-five or thirty times at least. (R. 1767.)

The stage of water during the time he was there was fairly uniform. Sometimes it got rather low, but there was no great flood at that time. The sand and mud bars were shifting to a greater or less

extent in the volume of the current, making a constant rearrangement. He was there in the months of October and November, and when he left he was accompanied by Mr. Galloway, a western man [Nathan Galloway], and a Mr. Knox, who had accompanied him into Glen Canyon from Columbus, Ohio, and was also interested in the mining venture.

The three of them took one of Stanton's boats and went down the Colorado River from near the mouth of Trachyte Creek to Lees Ferry, Arizona, where they left the river and went out across the desert [overland] to Flagstaff [Arizona], where they took a train for home. (R. 1768.) Started from near the mouth of Trachyte Creek in Glen Canyon. They grounded several times on the way down on shallows, and two or three times had to get out in the water and work the boat over the bars. Encountered quite a number of riffles, depending on the stage of the water, wouldn't call them rapids, but little steep places where the shallow water pitches off and becomes somewhat broken, but no rapids to any great extent; the only rapid is the one at Aztec C[illegible]ek; that is a little bit unquiet.

He makes [illegible] distinction between rapids and riffles: That you couldn't have a rapid with less than a fall of six or eight feet, in say, thirty or forty, and then you would have to have a certain volume of water, too. (R. 1768–1769.)

In the sections of Glen Canyon where he was making his observations regarding the placer min-

ing operations, they didn't need to have a trail as wherever there was a flood plane one could walk on that without let or hindrance, except in a few places where the willows were too thick. (R. 1770–1771.)

The placer apparatus they had in there consisted of rockers and cradles; they carried them down along the bank, sir, he means the lumber for the purpose of making sluices and cradles and that sort of thing. Stanton's dredge was not in there at that time; that was put in the next year. (R. 1771.) All of Stanton's supplies were brought in overland. None of them came either up or down the river in boats. The type of boats that Mr. Stanton used were about eighteen or twenty feet long, heavily constructed, and propelled by oars. He never tried to take a row boat upstream in the [Colorado] river. He may have come upstream in an eddy one hundred yards or so, but as far as making any progress upstream he has not done so. The boats that he saw come back empty upstream were towed and rowed. (R. 1772–1773.)

He next saw the Colorado River in the fall of 1909, when he started with four boats at Green River, Wyoming, and proceeded down the Green and Colorado Rivers to Needles, California. These boats were built especially for that particular trip; were built very light of cork pine, five-eighths of an inch thick, sixteen feet four inches long, with a

four-foot beam, and eighteen inches deep. They were keel boats, and they weighed about two hundred and forty-three pounds empty, and generally speaking, would draw five or six inches with an ordinary load and the boat's occupant. These boats had an oak keel and very light oak ribs. They were constructed at Detroit, Michigan, and cost about two hundred dollars each. They were shipped in to Green River, Wyoming. (R. 1773–1774.)

The other members of this expedition were Nathan Galloway, of Richfield, Utah; S. S. Dudendorf, of Myton, Utah; Mr. C. C. Sharp, of Nelsonville, Ohio; and Mr. R. A. Cogswell. This party left Green River, Wyoming, September 12, 1909. (R. 1774–1775.) Mr. Galloway had a boat to himself, so did Mr. Sharp, so did Mr. Stone; Dudendorf carried Cogswell in his boat. Cogswell was a photographer. Mr. Sharp and Mr. Galloway and he (Stone) carried the supplies through the expedition; that is, practically all of them.

Mr. Galloway had had a great deal of experience on the river, and he acted as guide as much as anybody could.

The expedition from Green River, Wyoming, down to Greenriver, Utah, made this progress: They naturally followed the river in the open part of it, between Green River, Wyoming, and the north Utah line, which marks the beginning of the entire canyon system, practically. Through that

open country they covered that in about three—maybe four days. Had quite a little trouble with sand and mud bars, but not to amount to anything; that is, they just impeded the progress, made a little bother in getting off of them here and there. (R. 1775.)

The canyon system of the Green River began when the expedition reached the north Utah line, and they continued down the river, meeting whatever difficulty they found in the best way possible. They encountered the first real difficulty in Red Canyon, when the boat occupied by Mr. Stone ran on a rock, and he also broke an oar in running the rapid at Ashley Falls. They continued on down the river to Alhambra, Utah, where they tied up, and went to Vernal for supplies. Vernal is located about fifteen or sixteen miles from the Green River, and Mr. Galloway had arranged to have a friend meet them at Alhambra with an automobile and take them to Vernal. (R. 1776.) They then continued down the Green River with the usual daily experience of turbulent water. It was somewhat wild in Lodore Canyon and to a lesser extent in Whirlpool Canyon, which immediately follows Lodore, and to some extent in Split Mountain Canyon. Then on down through Wonsits Valley, where the river is very quiescent for over one hundred miles, until you strike Desolation Canyon. In the valley where the declevity of the river bed is not steep they also found sand or mud bars.

(R. 1777.) The sand bars were more frequent where the river had a low speed. The transport power of water is a function of its velocity.

Made portages of the boats seven times coming down through these canyons, at different places where they unloaded the boats, between Green River, Wyo., and Greenriver, Utah; they portaged the boats twice in Lodore canyon possibly once in Desolation canyon; they portaged the loads probably half a dozen times, and in places lined the boats; that is, let them down past a difficult place with the bow line and stern line. That was done in some instances above as well as below Greenriver, Utah.

In that stretch of the river between Green River, Wyoming, and Greenriver, Utah, it was necessary to take the boats entirely out of the water twice in Lodore canyon, and once in Desolation canyon. That was accomplished in this way: The boats are emptied of their loads, and then pulled out on the rocks and transported over the rocks and put back in again when one gets below the turbulent part or the difficult part. Their boats were light enough, purposely so built, so that three men had very little difficulty in portaging them over the rocks; they were dragged over; but they didn't have to use skids at any time at all. (R. 1777–1779.) They met no other boats between Green River, Wyoming, and Greenriver, Utah, where they arrived October 9, 1909. (R. 1779.)

In this stretch of the Green River, the last twenty-five miles north of Greenriver, Utah, the water was fairly quiescent. There was some swift water in it, especially around a dam site, where a dam was being constructed above Greenriver, Utah, but nothing noticeably difficult, with the exception of an occasional sand bar. There was one place, he recalls, where a river was cutting into a wooded bank, cutting it away on the eastern side. (R. 1780–81.)

He supposes could have taken this same boat upstream from Greenriver, Utah, to Green River, Wyoming, but he wouldn't want the job. It certainly could not be done by one man. It could not be done with oars. (R. 1781.)

They stayed at Greenriver, Utah, about two days and left Greenriver October 11, 1909. (R. 1781.)

It is very difficult to say just now the amount of supplies carried at that time; they lived rather simply; our supplies consisted of flour, some potatoes, bacon, baking powder, salt and pepper; also had ham and some honey.

The boats were intended to be decked over, waterproof and air-tight fore and aft of the one cockpit where the oarsman sat; but unfortunately they were not constructed that way, and had nothing but a canvas flap over the bow; a very flimsy affair over the stern. They were practically open boats. (R. 1781–1782.)

He recalls that the boats grounded a number of times on sand or mud bars between Greenriver,

Utah, and the mouth of the San Rafael and that they experienced a good deal of trouble from sand bars all along through Labyrinth Canyon. There was also a good deal of swift water between Greenriver, Utah, and the mouth of the San Rafael. When the boats hit a sand bar they would sometimes have to get out and pull the boat over, and others where the bars were not filled with coarse gravel, they could rock the boat from side to side, in that way loosen the mud up, the current would take it away, and finally the boat would float off.

They possibly grounded one or two times from Labyrinth Canyon to the region of the cataracts, but not very much; the groundings and things of that kind being just incidents, and all in the day's work. (R. 1782–1783.)

The boats did not have rudders; they were flat bottomed, with a skag that could be detached, and in the more quiescent parts of the river we put on that skag to keep the boat from swinging too much, then we took that off in the swifter parts. This skag he refers to is a keel that projects from the underside of the boat down into the river, covering the lowest half of the boat, the rear, the stern. That was bolted on so they could detach that. It would be dangerous to try to run rapids—they practically went down stern first in all the rapids—they couldn't have done that with that skag on, so we detached that in the swift parts of the river and put it back on in the more quiescent parts, so

as to make it a good deal easier to handle the boats. That was his own idea, not tried before on that river. These boats were rather the outcome of Mr. Galloway's and his own experience and were quite different from any that had been built for that purpose theretofore. That appliance was afterwards used on what has been termed the Galloway type of boat. (R. 1783–1784.)

He describes this skag as a piece of oak two inches thick and about five inches in height at the stern, sloping down wedge shape to almost nothing at the center of the boat. Its purpose was the same as a fan-shaped centerboard, so that in quiescent stretches of the river where they went down bow first it kept the boat from swinging. (R. 1785.) They carried life preservers as part of their equipment. They were of cork that would sustain a dead weight of eighty pounds. (R. 1785.)

He describes the trip through Cataract Canyon as one continuous effort. The water is turbulent there with a great many rocks in the channel. At the head of practically every rapid, not all, however, they found a quiescent pool. (R. 1785.) They would land on either one side or the other, secure the boats firmly to rocks, then make their way down the talus slope to the foot of the rapid. By looking upstream they could easily identify the sunken rocks, the rocks immediately below the surface of the water that might be dangerous if you struck them. He could then pick out the best channel,

return to the head of the rapids and run the boats through. It would be rather foolish to go in pell-mell, without looking them over first. (R. 1786.) He does not recall how many rapids he found in Cataract Canyon, but I should say around forty that they counted as rapids in probably forty miles. Did not lose any boats in Cataract Canyon. It was necessary to portage some of the rapids. He does not recall how many.

These portages that were made required them to take the boats entirely out of the water; otherwise it wouldn't be a portage unless you did. At other places they lined the boats through. In lining the boats through, they unloaded them in some instances and in some not; that all depended on what that particular situation was; if they thought it was safe to line them without unloading them, they naturally got out of as much work as they could, and they didn't unload them. If they thought it was unsafe, they unloaded them, and portaged the loads down to where they could be loaded up again. (R. 1786–1787.) In one instance he purposely went into the heavy waves in a rapid in Cataract Canyon, because it looked as if it was free from rocks, and the photographer wanted a picture of a boat in big waves. The boat had about eighteen inches freeboard, but became filled with water. Everything was swept out of it except himself and the supplies, which were under the canvas covers. Two waves swept entirely over the boat

and himself, tore away the canvas fenders that had been built around the cockpits, but he succeeded in getting over to a sand bar immediately below the rapid where he pulled the boat on the bank, tipped it up, emptied the water out, and went on. He didn't try to do a thing like that again. (R. 1787-1788.)

Below Cataract Canyon they entered Narrow Canyon and found the river less turbulent, but there were still patches of swift water. They ran all the water in Narrow Canyon.

From Narrow Canyon on down to Lees Ferry the difficulties encountered were grounding on sand bars. (R. 1788.) They followed the same practice of getting off of the sand bar—pushing off where they could and going overboard where they couldn't push the boats off. They carried sufficient supplies, so it was not necessary to be resupplied any place between Greenriver, Utah, and Lees Ferry, Arizona.

Going through the section of Glen Canyon that he had formerly visited, he saw no placer operators in there on this trip. He saw three men from Searchlight, Nevada, who were going in to what is now known as Wrights Bar, about twenty or twenty-five miles above Lees Ferry, Arizona. (R. 1789.)

He saw Fred Gibbons at Hite, and visited Cass Hite a little lower down. There was still a post-office maintained at Hite, and they got mail there.

(R. 1790.) The placer claims were abandoned between his two trips; they were not productive enough to justify working them. (R. 1790.)

He met Bert Loper about the middle of Glen Canyon. He was on the east side of the river, pulling his boat up the river with a line. (R. 1790.)

He saw the dredge that Stanton had brought in. He believes it was located above Halls Crossing, but it was wrecked and in the river. It showed no evidence of having been operated recently. It would have been impossible to operate it, because it was sunk and covered with water and mud.

He reached Lees Ferry October 27 [1909], and it had taken sixteen days to come down to that point from Lees Ferry. They had hoped to find supplies at Lees Ferry; but were disappointed. (R. 1791.)

They had arranged for supplies to be brought in to Lees Ferry with a man named Emmet, who took the money but forgot the supplies and moved away. They were, therefore, not resupplied until the party reached the Grand Canyon, where they got supplies at the El Trovar Hotel.

When they arrived at Lees Ferry there were three men there from Searchlight, Nevada, and a cowboy, who was riding in the territory; no one was living in the ranch house. In his opinion he could not have taken his boat from Lees Ferry up to Hite alone. (R. 1792.)

He saw Bert Loper going upstream on the east side of a sand bar, towing his boat with a line.

From the mouth of the Green river to Greenriver, Utah, he could have taken this boat upstream there, possibly; certainly not rowed all the way; it would depend a good deal on the stage of water. (R. 1793.)

He has not written any book on the Colorado River. (R. 1793.)

Cross-examination (R. Vol. 10, pp. 1794–1798):

He encountered Bert Loper going upstream, somewhere near the middle of Glen Canyon, at the camp where he spent most of his time when with Stanton. Stanton was doing most of his prospecting there with a drill to find out where bedrock was in the stream. It was near the mouth of Trachyte Creek [on the Colorado River]. (R. 1794.)

Stanton didn't have any other permanent camp. The men working for Stanton were operating over possibly ten or twenty miles.

He believes there was one party that was working down pretty well toward Lees Ferry. He doesn't know where the supplies for that party came from, and doesn't recall any boats that took supplies down the river at that time. (R. 1795.) These placer mines extended further down than Hole-in-the-Rock. That company located practically all the gravel and sand bars in Glen canyon. (R. 1795–1796.)

He didn't see any boats go down the river to lower parties with supplies, and he only knew of one boat being brought up the stream empty. That boat was brought up by a party working their way upstream, surveying and locating placer claims. He believes this boat was brought up from Lees Ferry. The placer mining work at this time extended possibly half a mile above Trachyte Creek. (R. 1796.)

Sometimes a young man would tow a boat from the camp up as far as Hite and bring down supplies in it. He doesn't know the distance from Trachyte Creek to Hite.

The company that he was interested in went into bankruptcy the following year, and he believes its entire period of existence was probably about two years. (R. 1797.)

When they came down the river in 1909 the boats came down one after the other; usually Mr. Galloway in the first boat. Other men with him not familiar with the river. He had provided himself with the reconnaissance survey maps of the Geological Survey. Wherever they could they made use of these maps; found them sometimes in error, very much in error; they were of no assistance in enabling them to locate sand bars, rapids, anything of that kind. (R. 1797–1798.)

Redirect examination (R. Vol. 10, pp. 1798–1799):

He believes the Stanton dredge operated for about a quarter of a day, that it started operation

one day and a flood came down, broke it loose from its moorings, took it down three or four miles and left it there. (R. 1799.)

CONSTANTIN RODIN

For Complainant

(Record Vol. 10, pp. 1800–1811)

Resides at Santa Monica, California; 38 years old; Occupation, a fisherman. (R. 1800.) Understands skiffs, power boats, gasoline launches. Accompanied Bray-Pathe Colorado River Expedition as boatman. Frank Dodge, chief boatman. (R. 1801.)

Left Greenriver, November 10, 1927. Above junction of Green and Colorado a few riffles; get stopped, grounded; some of party get out and push boat off bars. First two days stuck a good many times. (R. 1801–02.) In Labyrinth Canyon, encountered sand bars, sand islands in river, channel divided, going both sides; swift current shoved them on bars or islands. (R. 1803.) Below Labyrinth Canyon had same trouble, but not so much as above. In Cataract Canyon two boats capsized in third rapid. The No. 4 boat, 18 ft. long; light boat, 16 ft. long, struck a rock and turned over. Party carried life preservers. Stopped at head of rapids and looked them over and picked out channel before running rapids. Lined boats; sometimes dragged over rocks. (R. 1804–06.) In Narrow Canyon had difficulty going

through sand bars; had difficulty where river shifted making big bend, sheer wall and swift current carrying boats right under, hard rowing to keep away from rocks and under bank. (R. 1806.) From there to Lees Ferry had difficulty at an occasional sand bar. A few riffles in that stretch (R. 1807) and bars with gravel on them; some boats stuck every day. Resupplied at Lees Ferry. (R. 1807–1808.) Between Greenriver and Lees Ferry saw one boat, tied up above Hole-in-the-Rock; met three Indians; saw no one else.

Cross-examination (R. vol. 10, pp. 1809–1810):

Worked hard to keep away from sheer walls after leaving Cataract Canyon. (R. 1810.)

Further examination (R. vol. 10, pp. 1810–1811):

Rapids and sticking in the mud were the kinds of difficulties encountered. (R. 1810–1811.)

VALENTINE WOODBURY

For Complainant

(Record Vol. 10, pp. 1811–1832)

He resides at Alhambra, California, is forty-four years old, his present occupation being manager of the Alhambra Steam Laundry.

He has had considerable experience during his life with boats, was two years on the United States training ship *Enterprize* as a cadet, has had intensive lifeboat training, two years on merchant ships,

two years in sailing, and two years in steamships. He has an official life-boat certificate and a second mate's license, unlimited as a navigator.

He made a trip up the Columbia River to The Dalles, Oregon, and portaged an eighteen-foot boat across to Fort Benton. He made a trip down the Missouri River to St. Louis, then up the Mississippi River to Grafton, where he entered the Illinois River, and from there on up to Chicago. This trip was made in 1925. (R. 1811–1812.)

During November and December, 1927, he was with the Pathe-Bray moving-picture expedition, as a boatman. This expedition consisted of six boats. The boat he had charge of was a little over eighteen feet long, about a four or five foot beam, with a four or four and one-half foot cockpit. The forward and aft compartments were sealed off with water-tight bulk heads, with water-tight hatches that screwed down on rubber gaskets that were used to carry the baggage, cargo, and radio. The boat he operated was the radio boat and they had everything under hatches, so that if the boat tipped over it wouldn't sink and would also keep the equipment dry. This was the same expedition of which Mr. Clark and Mr. Rodin testified.

Four of the boats were eighteen feet long or a little over, two of them about sixteen feet. There was a little sheer on the sixteen-foot boats, but the others were more or less straight along the top. (R. 1812–1813.) The boats were not equipped

with a detachable keel, nor has he ever seen a detachable keel or centerboard used on the Colorado River. They would draw, loaded, about eight inches. The boat he operated might perhaps draw a little bit more, as it was carrying heavy batteries and broadcasting equipment, but he would say the draft would not be over nine or ten inches at the greatest. (R. 1814.)

They carried a radio operator, one Sergeant Vern T. Herrick, whom, he believes, is now located at Monmouth, New Jersey.

It took them eight or nine days to go from Greenriver, Utah, to its junction with the Colorado River.

There was not very much delay in coming down the Green River because of taking pictures, as they took nothing but scenic shots on the Green River, although they did stop at Double Bowknot for a day and painted the boats. (R. 1815.)

From Greenriver, Utah, on down to the mouth of the San Rafael, the difficulties encountered were sand islands, sand bars, and rather coarse gravel bars. He describes one in particular just below the Denver and Rio Grande bridge at Greenriver, where the river spreads out, he believes one or two of the boats scraped there. Twelve or fourteen miles farther down two or three of the boats landed, and all of the boatmen hit their oars in going along because it was shallow.

They had some difficulty just below Double Bowknot, where he believes five of the boats were stuck

on sand bars, and at various places down the river they had some trouble. In many places their oars touched bottom in rowing. The oars were always used to sound with, to see if they were striking shoals. (R. 1815–1816.)

They encountered sand bars all the way down the Green. Below Double Bowknot several of the boys had to get overboard to dislodge the boats. Just below Greenriver a couple had to go overboard and lift the boats off the sand bar to get it loose.

They encountered no other boats along Green River from Greenriver, Utah, to its mouth. (R. 1817.)

They saw only one man, who was by a little cabin on the left bank of the Green River, about twenty miles below Greenriver, Utah. This was at noon the second day. (R. 1817–1818.) From the mouth of the Green River on down to the cataracts, the river is fairly narrow, contains plenty of water and, therefore, they encountered no difficulties in this four mile stretch. (R. 1818.)

His description of Cataract Canyon would be about the same as testified to by Mr. Rodin. There were forty-eight or fifty rapids in a length of thirty-nine or forty miles, and it was very rocky in Cataract Canyon. Most of the boats filled with water as they went through, but only one upset in the canyon. They were all very fortunate in that they were able to run every rapid except at the head of Dark Canyon. Frank B. Dodge was

the head boatman of the expedition and Mr. LaRue was the technical director. Mr. Smith was the assistant director of the movie company. Mr. LaRue did not assist very much in operating the boats. At times he would row for a little while, as all of the passengers did, to relieve the boatmen. (R. 1819.)

They came out of Cataract Canyon the day after Thanksgiving and stayed that night at Hite, Utah. The river through there appears to be all right, but is kind of boiling on the surface, rolling around, and the first thing you know, your boat goes sideways, or cuts around in a circle.

There are also bad whirlpools that get your boat completely out of control. This occurred more below Hite and closer to Lees Ferry. A few miles below Hite there is a rapid, known as Bull Frog, that has rather fast water; and one about one hundred miles above Lees Ferry that is called Whirlpool Rapids, which is rougher than Bull Frog, and rather swift water. Above one of these rapids they had boats stuck on the gravel and two or three men had to get overboard and dislodge them. He believes this happened above both Bull Frog and Whirlpool Rapids. (R. 1818–1820.) At the mouth of the canyon that leads up to the Natural Bridge, two of them grounded, and all down through Glen Canyon there were sand bars, different boats would lodge, and it would be necessary to get overboard to flood them off. (R. 1821.)

Below Cataract Canyon the river spreads out into a braided channel, one of which appears to be a good opening, but the water spills over the sand bar, and it is necessary to wash the boats through at the lower end. There is one braided channel above Hite and another some ten or fifteen miles below. They occurred at different places, but he remembers only two, at which places the river spreads to a width of five or six hundred feet.

In operating boats through these braided channels, he would just continue down the channel until he would hit bottom. Then he would shove himself off or get overboard and lift the boat off into deeper water, where it would wash through. He believes this happened two or three or perhaps four times. (R. 1822.)

Cross-examination (R. Vol. 10, pp. 1823–1829):

He describes the boiling condition further in the Colorado River as being the same thing as a boil in the Missouri River, and is caused more or less from submerged rocks. These boils catch the boat, carry it out of line, cut it around in circles, and it is difficult to get it back in to the main current. It is a kind of a whirlpool condition with a flat top instead of a vortex. They will take your boat out of control. He found this condition all along from about one hundred miles above Lees Ferry down to the ferry itself, and states that the boils are worse as one approaches Lees Ferry. He doesn't

mean that there is anything unusual about it, but that this same condition occurs in any river where there are rocks in the current. (R. 1823–1824.)

Above Bull Frog Rapid there were two boats on the bar where the men had to get overboard. He also has landed on a bar himself, but he can't locate the places definitely. He recalls the one at the mouth of the canyon that leads to the Rainbow Natural Bridge, where Dodge struck the shore on a rock or a gravel bar. He came in right behind Dodge and did the same thing. They had difficulty in getting off as there was swift water there. (R. 1825.)

There were lots of places where the boats struck, perhaps fifteen or twenty on the trip down, but they didn't all have to get overboard as they could sometimes shove off with their oars by standing on the stern, pushing, and lifting. There were lots of places where some of the boats stuck, some places where all of the boats stuck, and he believes they were all stuck just below Double Bownot on the Green River. (R. 1825–1826.)

He doesn't recall that any of the boatmen were criticized on the trip on account of paying too much attention to the scenery, causing five of them getting on the bar at Bownot. They were attending to the business of getting the boat down the river. (R. 1827.)

The business of the trip as far as the camera men were concerned was to get interesting pictures.

He was the boatman and when he was ordered to stop or get into a certain position, he did so. He believes that at Bull Frog, just below Hite, about all of them hit the bottom and dragged over it, but all of them didn't have to get out. It took the radio man and himself fifteen minutes to push themselves off with oars over the shallow part of the river. (R. 1828.)

Further examination (R. Vol. 10, pp. 1829–1830):

He had never been on the Colorado River previous to this trip and he didn't use any maps himself. He knew that Mr. LaRue and Mr. Baber, the New York Times reporter, had a topographic map, showing the fall of the rapids in part. (R. 1829–1830.)

There was much less water in the Green and in Stillwater canyon than there is on the upper stretches of the Missouri; much more difficult to navigate. (R. 1830.)

Redirect examination (R. Vol. 10, pp. 1831–1832):

He was able to accurately view the river, but not to locate the deep water. In many places there was apparently no deep water, as it spread out. His experiences told him that generally on a river he would be able to locate the deep water by the riffles and by where a sand bar drops off. He has learned that from experience, but in coming down the Green River to the Colorado River, he could not

always tell; for many times there was no indication. (R. 1831–1832.)

RAYMOND M. PRIEST

For Complainant

(Record, vol. 10, pp. 1832–1845)

He is forty-six years old, resides at Yuma, Arizona, and by profession is a civil engineer. He received his training at the University of Arizona and has been actively engaged in his profession for about twenty-six years, mostly in investigations and surveys, with some construction work. At the present time he is employed by the United States Government in the Bureau of Reclamation.

He is familiar with the San Juan River from Arboles, New Mexico, located about forty or fifty miles above Farmington, New Mexico, to a point about twenty-five miles below Bluff, Utah. (R. 1832–1833.)

In 1914 he made an investigation for the Bureau of Reclamation of dam sites and reservoirs, under N. P. Conway, who was chief of party. The other members of this surveying party were a lad named Dahl and Porter Merrill. The purpose of the work was to make topographic surveys of dam and reservoir sites. (R. 1834.)

He started at Farmington, New Mexico, and took a bus to Shiprock, New Mexico, where he rented a saddle horse and started down the San Juan River. He arrived at Bluff two or three days later and

from there went on down to the Gooseneck, located in the vicinity of Mexican Hat on the San Juan River. He was seeking dam sites to be surveyed by the party.

He found a desirable dam site at the so-called Gooseneck, and made his way back to Bluff, and back to the party, which was working on the Dolores River.

After the completion of the work on the Dolores River, they moved to Bluff, and began a topographic survey of the dam and reservoir site. He was not with the party all the time, as his duties were seeking reservoir and dam sites, to be later surveyed. (R. 1834–1835.) This dam site he is referring to is what appears on the Reclamation Bureau map of 1928, Compl. Exhibit 2, as Bluff dam site. (R. 1835.)

In going down the San Juan River from Arboles to Mexican Hat, he was frequently in sight of the river, as that was part of his work. He traversed the river bed practically all of the distance from Farmington to Arboles; and from Farmington to Bluff, Utah, he followed the roads that lead down the river. A passageway along the banks of the river was impossible in many places, but you could get in to the river here and there and view it, which he did, but didn't follow immediately down the bank from Farmington to Bluff. This was in September, 1914. (R. 1836.)

The water in the San Juan River was at a low stage; he believes not the minimum low stage, but

in general, the river during the months of October and September, unless there are rains, is low.

He crossed the San Juan River both above and below Bluff, which crossings were necessary in order to make the surveys. He took into consideration the character of the river bed, as that was part of his scientific work. (R. 1837.)

The bed of the stream was quicksand; very dangerous in fording, and in most places sand waves were running. Some of these were twelve to eighteen inches in height; and the water was shallow, not more than twenty-four to thirty-six inches deep on the average. (R. 1838.) Water about twenty-four or thirty-six inches deep; it seemed uniform throughout the whole stretch of river we worked on.

A possible dam site was located, of course, in the canyon between two narrow walls; at that particular point we had rock clear across the bed of the river he has been previously referring to, the river bed above the dam site, where it widens out into the reservoir site. The dam site just had rock across the stream bed. (R. 1838.)

A dam site was surveyed on the San Juan River, just below Chinle Creek, as it was planned to take in the discharge of this creek. At this point a dam was contemplated about two hundred and fifty feet in height above the bed of the stream. A dam this high would submerge the whole area in the reservoir site probably forty or fifty miles

above the dam. It would have submerged Bluff completely, and, as he recalls, it would back the water up some twenty or twenty-five miles above Bluff. (R. 1839.)

He knows of no streams above the dam site, up as far as Farmington, New Mexico, that run all the year around, except possibly the Mancos River. At the time he saw the Mancos River it was maybe flowing twenty or thirty second-feet. The Mancos enters the San Juan River about twenty or thirty miles below Farmington, New Mexico. (R. 1840.)

In figuring a dam at this point he took into consideration the effect of the sand and silt. He had no silt samples taken and had no figures on it, but took it into consideration in submitting his report. He didn't make a reconnaissance of the possible irrigable lands above the dam site, as the purpose of the reservoir on the San Juan was not for irrigation of any area of the San Juan. The idea was for upstream storage of the Colorado River for flood control. (R. 1841.)

On the lower river they have an annual summer flood, melting snows; in the upper reaches of the Colorado River the investigation work was started in this year, 1914, with the idea in view of surveying reservoir sites and dam sites that would store this excess water, or the summer run-off from the melting snow, to control these floods. This Bluff dam site on the San Juan was for the partial purpose of controlling that degree of the

flood that came down the San Juan into the Colorado. The general purpose of these dam sites was similar to the purpose of the Boulder dam—for storage.

There is no irrigable area on the San Juan below this dam site that he knows of; it is all in the canyons from there down. (R. 1842.) There is some irrigable area above the dam site, but he knows of none in the Navajo Reservation south of the San Juan River. He was in and about the San Juan River in 1914 for four or five weeks, and during that time he never saw any boats on the San Juan River at any point. (R. 1843.)

Cross-examination (R. Vol. 10, pp. 1844–1845):

In speaking of irrigable land below the dam site, he means below the site of the dam itself. If this dam should have been built, the water backed up for approximately forty miles.

Although you widen out into a valley and bluff there, the sides of the San Juan valley are precipitous, and you would really submerge with the dam site all the irrigable area in that vicinity, and he doesn't believe the surrounding country could be developed for irrigation by pumping, and it is poor soil. (R. 1844–1845.)

Further examination (R. Vol. 10, pp. 1845):

This project that he was making a reconnaissance for was for the federal government.

THOMAS G. GERDINE

For Complainant

(Record, vol. 10, pp. 1846–1892)

He resides at Sacramento, California, is fifty-seven years of age, by profession a topographic engineer with the United States Geographical Survey, and has been employed by the United States Government for practically thirty-six years. His title is Division Engineer and his headquarters are at Sacramento, California. The territory that he covers consists of practically all the states west of the Rocky Mountains.

He had charge of the survey parties, making a survey on the Colorado River. (R. 1846–1847.) These surveys were made in 1921, and primarily were to determine the extent and capacity of a reservoir above a proposed dam site, located about five miles above Lees Ferry, Arizona, in Glen Canyon of the Colorado River. This survey was made with the knowledge that there might be a dam eight hundred feet high at that place, the data collected being for that height of dam, and the work done in cooperation with the Southern California Edison Electric Company.

He wasn't on this particular work throughout the entire survey, as he had many parties throughout the west, and he tried to visit all of them during the field season. He first entered the Colorado River Country in July, 1921. (R. 1848.)

He went from Flagstaff, Arizona, across the Painted Desert to Lees Ferry, Arizona.

After he arrived at Lees Ferry, he went on up the Colorado River in a boat built by the Southern California Edison Company, a distance of about twenty-eight miles to the mouth of Warm Creek, which he believes is located just inside the state of Utah, and then went on horseback over the mesa. (R. 1849.) It was a flat-bottom scow with flared bow and stern—no, the stern was not flared; no slope on either side; my impression was it pointed a little at the bow; square sides, and had a barrel structure in the stern of the boat to enclose the propeller. It was propelled by a marine engine, and that engine was tied up to a shaft; the shaft propelled the screw. My recollection is it was a forty-horsepower engine; I can not say definitely how much horsepower engine, but my recollection it was forty-horsepower engine. The purpose of the load was to carry supplies, if possible, from Lees Ferry up the river to the rapids below the mouth of the San Juan River, to replenish these topographic parties that would be operating from that as a center, and they had hopes we would take a considerable amount of supplies up by that boat.

The supplies carried were about a thousand pounds food supplies, and then when the various men that were along with the expedition were inside the boat—there were seven or eight men—that would make about twenty-five hundred pounds

when the boat was full of men and supplies. The boat was about twenty-seven feet in length—twenty-seven feet in length, about seven-foot beam; that is my recollection of it; that is my memory. (R. 1849–1850.) Photograph No. 260 [in Compl. Exh. No. 11 D] represents the boat.

They unloaded the boat at Lees Ferry and placed it on a large truck and drove it overland from Lees Ferry to the upper part of what people locally call the dug way. That is the descent from the mesa down into the canyon of the Colorado River. They then let the boat down with a block and tackle to the water edge. This was two and one-half or three miles below Lees Ferry, just below the Paria Rapids. (R. 1851.) It was a gasoline-propelled boat; and then the engine was started; there were several around; were all very much interested in the boat; didn't know what it would do on the river; we started it more or less experimentally; there were several—two or three of the government men—two or three representatives of the Southern California Edison Company, the man in charge of the motor, and one or two others; seven or eight men were on that boat when we started up; just below Paria rapids there is quite a current comes in next to the bank on the east side. He recalls distinctly the boat did not respond as it should; went over next to the current, and all jumped on one side to keep it away from the canyon walls; very nearly capsized there, but seemed to get

quieted down; the boat made pretty good progress up to the foot of the rapids, Paria rapids, below Lees Ferry; in what would be called comparatively easy water, below the Paria rapids; wanted to see if the boat would go up Paria rapids; felt confident it would go up the stream; it wouldn't go up Paria rapids under its own power; had to get out and help tow the boat through the greater part of the rapids, perhaps half way up the rapids.

Then there wasn't water enough; it had shifted over toward the east bank of the river, and the man in the tow line pulling had to turn loose—Mr. Cobb was the boatman in charge of the boat; he got out, and with the assistance of Mr. Cobb lifting it over rocks and things of that kind, and its own power, they finally got it up over the rapids.

Then it was easy going in to Lees Ferry. That was the end of the second day from Flagstaff. The next day we put on this load on the boat, docking it up as far as we could carry it with supplies for the men doing the topographic work in connection with the survey, and we made about fourteen miles the first day.

Quite a few times we got out on the banks and helped tow the boat, to make time; it could just hold its own against the current. That was just a swift stream there; there were no rapids or riffles in that part of the stream—yes; just before nightfall we struck a riffle, and tried to make it and couldn't, and dropped back down the river, and

stayed overnight just below the riffle. In the 14 miles did not strike what he calls sand bars; they struck bottom every now and then; that was on account, you might say, of poor navigation. If we had shifted over a little bit we probably would not have struck bottom. (R. 1851–1853.)

The location of the bar or shoal that caused the boat to drop back is about eleven and three-quarters of a mile above Lees Ferry. (R. 1853–1854.) He is testifying in connection with Compl. Exh. 10, sheets A and following. (R. 1854.)

The next morning a reconnaissance was made and it was found to be much easier to go on the south bank of the river, rather than take the main channel, as the bar or riffle stretched practically across the river. By the men pulling, and using the boat's power, it got by all right. The remainder of the distance up the river was made very well, except that the boat would strike bottom now and then. They got to Warm Creek, had a little lunch, dropped down the river to a spring, and cached the provisions they were taking up, so the topographic parties could pick them up in the small boats they were using. (R. 1854–1855.) They didn't continue on up the river, but went back up to Lees Ferry. It was too much of a struggle to go upstream. They had plenty of fuel, and he recalls Mr. La Rue saying that there was in the neighborhood of twenty-five to twenty-eight thousand second-feet passing Lees Ferry at the time.

He made a subsequent trip on the same boat, up the river five or six miles above Lees Ferry, and had no trouble to speak of. (R. 1855–1856.) This boat was at Lees Ferry the last time he heard of it. After this second trip was taken, some of the party found a trail leading up the mesa, just north of Lees Ferry, that could be used as a pack trail for carrying supplies up parallel to the river. The largest amount of supplies used by the party which was working the lower part of the reservoir site was supplied by pack trains. (R. 1856–1857.)

He had three principal parties along the Colorado River at this time, one of which was in charge of Mr. Chenoweth, which party was to descend the Green River from Greenriver, Utah, to the Colorado, and then down the Colorado as far as possible. He started to visit this party from Hanksville; but could not get to them on account of a washout in the Dirty Devil River below Hanksville. He, therefore, didn't visit the Chenoweth party after it left Greenriver, Utah. (R. 1857.) At the time he tried to visit the Chenoweth party he went from Greenriver to Hanksville in a car, expecting to go on from Hanksville by horseback. He didn't get horses, however, as he met the packer coming back, who told him that Chenoweth had already left the mouth of the Dirty Devil River.

Mr. Trimble was in charge of the party that started at Bluff and carried the work down the San Juan River to its mouth, and then down the

Colorado River for perhaps twenty miles. He visited Mr. Trimble on the San Juan River opposite the mouth of Copper Canyon. (R. 1858.) He made this trip by automobile from Greenriver by Moab, Monticello, and on to Bluff; then by wagon and by walking to Gosdrich, where he met a boy employed by Mr. Trimble with a pack train, and he went on to the mouth of Copper Canyon by horseback. It took him two days to go from Greenriver to Gosdrich, and he spent a day with Mr. Trimble. On this trip the only boat he saw was a small skiff that Mr. Trimble had. (R. 1858–1860.) Mr. Trimble was mapping the country, taking the topography up to the limiting contour that was thirty-nine hundred feet above sea level. He, Gerdine, was supervising the work, and visited Mr. Trimble to see that he was getting along all right, to see if he was keeping up with the schedule, and what, if any, obstacles were ahead of him, so that if he didn't complete the work allotted to him other men could be put in to try and complete the job in that one season. (R. 1860.) A limiting contour is this: they carried the topography up to the thirty-nine hundred-foot contour, thirty-nine hundred-foot contour above sea level, and disregarded everything above that. (R. 1860–1861.)

This limiting contour was approximately the upper contour of the proposed reservoir site, and the map was made primarily to make an esti-

mate of the storage capacity of the proposed reservoir. They might have constructed a dam of any height, that was simply to get the data up to thirty-nine hundred feet, so they would have the data if we wanted to construct that high; they never proposed to make a dame that height, eight hundred-foot dam in that canyon.

The contour figures on Compl. Exh. 10 do not show the height of the canyon walls, necessarily, but only go up to thirty-nine hundred feet. There may be places on the map where the topography is above thirty-nine hundred feet. He believes generally throughout the whole map you will find the upper or limiting contour is a thirty-nine hundred foot contour. (R. 1861–1862.)

He then returned to Greenriver, Utah, over the same route on which he came in, visited some other field parties, and later went back to Lees Ferry. (R. 1862.) He had one other party in the immediate section, in charge of Mr. Fowler, who was working on the lower river in the vicinity of Warm Creek. He visited Mr. Fowler at this point, going in on horseback from Lees Ferry, Arizona, where Mr. Fowler started his work; Mr. Chenoweth commenced his work at Greenriver, Utah, and Mr. Trimble at Bluff, Utah. (R. 1863.) He explained that the map is dependent for direction on the magnetic needle, the elevations dependent on spirit level elevations, and that the horizontal measurements are made with the telescopic alidade

used on a plane table. The whole map depends on a system of graphic triangulation, run from a base line; and from this base line the triangulation is graphically expanded on plane table sheets. The contour line, as shown on the map, is from a basic elevation, run by spirit level lines, and are carried from the basic lines by means of vertical angles. (R. 1864.) The contour lines on the map are lines supposed to represent equal elevations above sea level, and are as correct as it is possible to determine them. Enough elevations are determined throughout the area to enable a man to sketch those contours as near as he can depend on the scale of the map. All of the measurements that appear on the map are determined by scientific instruments, and barring a probable error which exists every place, are correct.

The blue line on the map, Compl. Exh. 10, Sheet A, represents the edge of the stream at the time the survey was made. (R. 1865.) Its width and shape is determined by scientific instruments. The straight brown lines inside of the blue lines indicate five-foot contours, which between lines show a five-foot fall in the river. The circles, enclosing numbers, indicate the mileage above Lees Ferry, along the center line of the stream. (R. 1866.) That is ascertained by traverse; they make the map, then simply step off a mile, and two miles, and so forth, and simply draw this out so we can correlate the profile of the stream with the plan of the river.

The letters "B. M.," after that, "3148," means bench mark, a permanent bench mark along a spirit level line, a precise level line run by the survey between Greenriver, Utah, and Flagstaff, Arizona, and is the basis for one of the elevations on this map. If you follow up stream you will see any number of permanent bench marks established along that river. It would be above the bed of the stream. It is a concrete post with a brass tablet set inside with the elevation stamped on it. (R. 1866–1867.)

He explained that between mile three and mile four, where the No. 4300 is noticed, it simply means the topography at that place was up to the forty-three hundred foot contour, and that the contours were merely sketched in up to that elevation. (R. 1867–1868.) There were many places on the Colorado River where the walls are much higher than thirty-nine hundred feet, which would not be shown if the map only was made to show contours up to thirty-nine hundred feet above sea level. Each contour line on the map represents a rise of twenty feet. This contoured interval is indicated on the map. He then explained that the blue line as shown at mile eleven represents a stream course with water in it, and a blue broken line represents an intermittent stream course. (R. 1868.) These markings are standard on all maps, and the double line, running down the side of the river at mile twenty, represents a second class road, is a stand-

ard symbol on practically all geological survey topographic maps, and is understood by persons using the maps. This symbol is also indicated on Sheet A, showing a road down Wahweep Creek.

This road continues to the vertical line, marked DD on Sheet A, and, turning to Sheet B, we find the same vertical DD line, represented on this sheet, which is simply a junction line between the Sheets A and B, showing where they properly join together. [The road is then shown on Sheet B, continuing down to where a dotted line joins it from the south, and denotes a trail to Lees Ferry. The road then leaves Wahweep Creek at this point, and goes northeast to Warm creek, joining Warm creek about two miles above its junction with the Colorado River.]

He then indicated on Sheet B the dotted black line representing a trail to Lees Ferry. His attention was then directed to Page 10, Sheet J, of Compl. Exhibit 10, and he explained that the dotted line on the right-hand side of the river is a trail. He explained that in topography the distinction made between a road and trail is that a road is one that can be travelled with a vehicle, and a trail is passable for pack animals and on horseback. (R. 1869-1870.) He explained that the topographer is supposed to show all roads, and if there are well-defined trails they are supposed to locate these trails also. His attention was then directed to Page 55, Sheet T, of Compl. Exh. No. 10, and he explained

that this represented a profile of the river, showing the height of the river at the time the survey was made. During the progress of the survey frequent elevations are made of the water surface, and in connection with the drawing of the plan of the map they make a profile, which is a vertical section of the river, based on elevations established at the time the survey was made. From the profile he is able to determine what sections of the river contain rapids.

He stated that rapids are in various slopes; one may have a fall of five feet in one hundred yards, or a swifter one a fall of ten feet in one hundred yards. (R. 1871.) As a rule, when water has a gradient of ten feet to the mile, there would be a lot of rapids in that mile.

He stated that the topographers took elevations above and below each rapid, and that is done with an instrument. (R. 1872.) Referring to Compl. Exh. No. 10, Page 55, Sheet T, just for the purpose of the record, to illustrate, take on this same sheet you refer to, from mile 204 to mile 206, the drop in there is the difference between 3,765 and 3,792; that would be about 27 feet in those two miles. To get that: This is elevation [indicating]: here [indicating], this 3,760 or 3,765, is practically the surface of the stream; at mile 204 it continues to rise to 3,770 at that point, 3,775, 3,780, 3,785, 3,790 at No. 205; then it goes up to 3,795 about there, and 3,797 at that point. Each one of those

is five feet in fall. At the various stages of the river a survey will show a different profile. As the river rises, usually a number of rapids are obliterated on account of the height of the water. When he says obliterated he means instead of having several small rapids you will have one large one.

The presence of rocks or sand bars make a difference in high water. Its influence would be shown; it depends entirely on the stage of water. With a thirty-foot rise in the lower Colorado, in Marble canyon, you might not see the result on any rapid at all, on account of a sudden rise, but in a twenty-foot rise you might see quite an influence in the surface of the water, it would be perceptible, yet it wouldn't be what a swift-water riverman would call a rapid. He would rather go down in high water than in low water. He wouldn't like to have it too high, though. The difficulty which arises from a rapid is not necessarily from the swiftness of the water or the amount of drop, but it is from the obstacles in the way of the boat, combined with that swiftness; it is the result of rocks and boulders in the stream that produces all kinds of waves and cross currents, and so forth; what the river boatmen consider most dangerous is to get between those rapids, between those rocks. If they had a chute right through, they wouldn't consider it difficult. But

in attempting to avoid those rocks is the danger in the rapids. That is his understanding.

A stream would have considerable rapids in it with ten feet to the mile.

Assuming that the river was entirely unobstructed by rocks or sand bars, there is no particular difficulty in navigating in having a boat go down the stream, unless you have some awful curves that would throw you up against the bank. The chief dangers and difficulties arise from the combination of a drop in velocity with the obstructions in the river bed. (R. 1872–1875.) Sand bars are designated on the topographic map in some places, and referring to Sheet D, Page 4, of Compl. Exhibit 10, at about mile forty-four and also between mile forty-four and forty-five, the sand bars are indicated by the symbol along the edge of the water. (R. 1876.) It is shown adjacent to the alluvial plane, and when the river is high it is probably submerged. Anybody coming down the river at the time the map was made, and seeing the map, would have no obstruction at all, although the influence of the sand bar might extend out into the water, as it probably does, but it is not shown on the map as only the exposed portions of a sand bar would have shown at the time the topographer went through there. (R. 1877.) On Page 6, Sheet F, of Compl. Exhibit 10, at miles 60 and 68, sand bars are shown out in the channel of the river

itself. These indicate a sand bar or sand island at the time the survey is made. (R. 1877-1878.)

Further examination (Vol. 10, R. pp. 1878-1880):

The SPECIAL MASTER. One or two witnesses, possibly more, I don't recall, have testified that if they had had a map like this it would not have been of any assistance. Some said, I think, it would not be of much assistance. Why are these bars, then, designated on this map? For what purpose?

"A. Simply a physiographic feature that exists on the ground.

"Q. These maps, I suppose, are designed for some future use, not merely to represent the immediate condition at that time; are they?

"A. The object the Geological Survey would have—its purpose in cooperating with the Edison Company, is to have a map of that region; the Geological Survey is making a mother map of the United States; this would be incorporated and become a part of that mother map.

"Q. What I am trying to see is, if those bars are of such temporary nature that this map would not assist a person coming down the river, what is the object of putting them on the map?

"A. Because they existed at the time the map was made. You want to make the map a faithful representation of the terrain at the time it is made."

By Mr. BLACKMAR:

"Q. That is, you show all features on the map which appear to the eye up to a contour of thirty-nine hundred feet, or to an elevation of thirty-nine hundred feet?

"A. Yes, sir."

The SPECIAL MASTER. He has testified, as I understand, that all bars are not shown.

Mr. BLACKMAR. All bars that are exposed and can be seen. Of course, a bar which was below the water at the time the map was made——

The SPECIAL MASTER. Are rocks shown?

"A. I don't think they are; no, sir.

"Q. What I am trying to get—I am not intimating anything one way or the other—for instance, on the Coast Survey, a map or a chart would show every reef, every bar, and every sunken rock, and all that sort of thing. Those are intended for future use, to guide navigators.

"What I am trying to see is how far this map is intended for a similar purpose.

"A. It is not intended for purpose of navigation at all."

Mr. BLACKMAR. Of course, those features your Honor refers to must necessarily be made by soundings. A reef not exposed would have to be made by sounding.

The SPECIAL MASTER. I don't believe there are any rocks shown on there. (R. 1878–1880.)

Cross-examination (R. Vol. 10, pp. 1880–1888):

Rocks were not shown on the map, as he didn't think the scale of the map was sufficiently great to show all of the rocks in some of the falls or rapids. (R. 1880.) If there were a pinnacle of rock that would stick up out of the river as a noticeable physiographic feature that might be shown; but there were so many rocks in the rapids that they could not be shown on the scale the map was drawn to. The map shows, or was designed to show, all the sand bars that were apparent above the surface of the water. (R. 1881.)

He believes the draft of the boat he went up the river in was about eighteen inches when loaded, had a screw propeller, which was in a barrel [tunnel] and probably was flush with the bottom of the boat, which he examined before it was launched. (R. 1882.) He had only one party working up the river from Lees Ferry [the others were working down from the Green and San Juan]. The place where he left the supplies was not in an appointed cache, but they were forced to cache the supplies, as they knew the topographers would pick them up easily. They would notice the spring and notice the cache. (R. 1883.)

When he was at Lees Ferry Chenoweth's party was leaving Greenriver, Trimble had started at Bluff, Utah, was coming down the San Juan River, and he knew their general locality. He had an

agreement to cache supplies near the mouth of the San Juan River if possible. (R. 1883–1884.)

The point at which they turned around to go back to Lees Ferry was at the mouth of Warm Creek. They had pretty good water in the river at this point. The boat was working successfully. They were going upstream, but were tugging a lot on the line. The conditions had been as favorable below this point as at the mouth of Warm Creek. (R. 1885.) They left Lees Ferry at eight or nine o'clock in the morning in the month of July, and camped the first night about twelve miles above. They tried to get through a riffle, opposite mile twelve, and didn't make it, but dropped down and camped on the east side of the river just opposite a sand bar. They were pretty tired and had done a day's work; it was getting dark, and so they stopped there. (R. 1886–1887.)

His recollection is that they got to Warm Creek about one or two o'clock in the afternoon the next day, then dropped back downstream to the spring he spoke of, and made the cache of supplies on the east side of the river. His men were to pick up these supplies with small boats that they were using and take them where they might be required in their work; that would be at the mouth of Warm Creek and on up Warm Creek to the plateau above. At the time he left these supplies there he knew of no trail or road up or down the river on that

side, and he has no knowledge of such a trail or road at this time. (R. 1887–1888.)

Redirect examination (R. Vol. 10, pp. 1888–1889):

The boat he has testified to was designed by the Lighthouse Service, and the design was sent to the Edison Company in Los Angeles, California, who let out a contract to a firm in Wilmington [California], named Fellows & Company, he believes. (R. 1888.) Mr. LaRue was along on the first trip as far as Warm Creek. (R. 1888.)

Upon viewing Photograph No. 260 of Compl. Exh. No. 11 D, which was taken August 9, 1921, he decided that his first trip was taken at that time, instead of in July, as he before testified.

The upright post that appears in the picture of the boat, with a line attached to it, is a standard to which the line was attached for towing the boat.

Attention called to Compl. Exhibit No. 90; stream-flow record at Lees Ferry, August 9, 1921, seventeen thousand five hundred [second feet]. (R. 1888–1889.)

Further examination (R. Vol. 10, pp. 1889–1892):

By the SPECIAL MASTER:

"Q. I may be a little stupid, but I still can not see why these maps wouldn't be of some assistance to a person coming down the river. These topographic maps, sheets A and B, which represent the Colorado River from Lees Ferry to the junction,

the Green, and Grand, and the San Juan River, were made in the summer months, I understand?

"A. Yes, sir.

"Q. Now, if a person having these maps in his possession knew they were made in the summer months, and saw sand bars designated, and knew those were exposed sand bars, if he was coming down the river when there was higher water, wouldn't the designation of these bars give him warning that there was shallow water ahead of him, if the bars were exposed in the low waters there would be shallow water over the bars when the river was higher, wouldn't the fact that he saw these on this map give him warning as he came along that there was going to be shallow water or the likelihood of it?

"I understand the bars shifted and changed, but at least he would be warned that there was the likelihood of shallow water, wouldn't he?

"A. Yes, sir.

"Q. Why wouldn't that make a map of some assistance?

"A. The map primarily——

"Q. I understand it is not for the purpose of navigating.

"A. As a matter of fact, the five-foot contours across the surface of the water is the real warning to navigation. If you get up in the Cataract rapids or the principal stretches where there are rapids, and notice these five-foot contours, how close to-

gether they are, and if you knew how to read the map, you will be rather careful going down the declivity of a stream of that kind.

"Q. It would give warning of rapids in the descent of the stream, but this sand bar business, I don't see why, if he knew these were exposed in July or August, and in September he came along—this higher water period—I don't see why that wouldn't warn him that there was likely to be shallow water there, and to keep to the other side of the river.

"I understand thoroughly that there is evidence that these may shift and change, but at least he would be given warning that he better look out.

"Mr. BLACKMAR. That is, it would amount to this, he would have reasonable cause to suspect there should be a sand bar—or would be a sand bar.

"The SPECIAL MASTER. Yes. And to that degree it seems to me, as a layman—I never navigated a boat down rivers to this time—but just as a layman it would seem to me that maps of this kind must be of some assistance to a person coming down the river.

"The WITNESS. The Colorado is an awfully muddy stream in the lower stretch. I don't know whether you could see the effect of that sand bar.

"By the SPECIAL MASTER:

"Q. I am not talking about seeing it, at all. I am merely talking about possible warning he might have that there was trouble ahead if he had a map of this kind.

"A. I think the sand bars would be a warning, or would be to an extent a guide in navigating that stream downstream. I think, however, the contour crossings of the stream showing the profile of the stream are a far better index of what you would find than simply the sand bars." (R. 1889–1892.)

WILLIAM HIRAM EDWARDS

For Complainant

(Record, vol. 10, pp. 1892–1945)

(Record, vol. 11, pp. 1948–1981)

He was born December 6, 1866, and resides at Compton, California. He finished the eighth grade in school and went to work. His father died of tubercular trouble, and it was considered best for him to come west, so he went to California in 1887 when he was twenty years old.

For the next ten years he lived in the outdoors all the time, working with mining companies, railway surveys, cattle ranches, and other work of that kind. For the past thirty-two years he has been in the ice-manufacturing business and now operates a plant at Compton, California. (R. 1892–1894.)

He knew Robert Brewster Stanton, and first met him in Denver, Colorado, when he applied for a job to go down the Colorado River. He was employed by Mr. Stanton, joined the Stanton party at Denver, Colorado, and proceeded with this party to Greenriver, Utah. (R. 1894.) The boats were

not at Greenriver, Utah, there at that time, but they came in within the next couple of days from Waukegan, Illinois—three of them.

They were oak boats twenty-two feet long, four and a half foot beam, thirty-two inches deep, being keel boats; they had ten air-tight compartments along the sides and ends. The two in the ends were water-tight, with water-tight hatches in which we packed perishable supplies such as photographic material and stuff we didn't care to have wet; the other provisions were packed in rubber sacks made especially for this trip; they would hold about two twenty-five pound sacks of flour, and other provisions that might be damaged by water. These rubber sacks had a fold top which, when rolled tight and laced, made them water-tight. Lost them and picked them up a week afterwards in good condition. This was what is known as the second Stanton expedition. There were 12 in the party. The survivors are Mr. Kane, Mr. McDonald, Mr. Nims, and himself. (R. 1894–1895.)

From Greenriver, Utah, the party proceeded to Hanksville, the boats being loaded on wagons, and were hauled overland from Hanksville down what was then known as Crescent Creek to mouth of that creek on the Colorado River.

Crescent Creek is the same thing as North Wash, its mouth being located about five or six miles up the river above Hite, Utah. There was a wagon road from Greenriver in to Hanksville.

The country was a semiarid, dry country; no population. He recalls that the second or third night out from Greenriver, Utah, they made a dry camp because there was no water from the time they left the San Rafael River until they reached Hanksville. They carried water on the wagon in barrels. (R. 1895–1896.) At that time Hanksville consisted of possibly four or five houses. From Hanksville they went to the head of Crescent Canyon [North Wash] and down this canyon to the Colorado River, where they launched the boats. He believes the expedition started down the Colorado River December 6 or 7, 1889.

The purpose of the expedition was to make a railway survey of a proposed railway, called the Denver, Colorado Canyon and Pacific Railroad, that had its original starting point from Denver and crossed the range [Continental Divide] about where the Moffat Road is, down the Grand River [Colorado] to the junction of the Grand and Green Rivers, down the Colorado River to near Eldorado Canyon, and down across to San Diego, California. (R. 1896–1897.)

After they launched and loaded their boats at the mouth of Crescent Creek they dropped down to Hite. Mr. Cass Hite lived there at that time. Then they continued on down to what is called Tickaboo Bar, where Mr. Stanton met some parties from Omaha who were there investigating placer mines.

He recalls they got hung up on a riffle right at Hite and had to get out and push the boats off. He explained that forty years is a long time to recall every time the boats were stuck and that he can remember lots of the instances, but not all; but he knows they were on bars quite a good deal, especially farther below Tickaboo Bar.

His capacity with the expedition was boatman and assistant cook. (R. 1898.) He had had some experience prior to this expedition on Lake Ontario as a boatman, and had had some experience as a cook; had, in fact, applied for the job as cook, but they already had a cook "that couldn't boil water without burning it"; so he had to take the job over. They had no difficulty from Tickaboo Bar on down to Lees Ferry, except on account of extreme shallow water. They had to make one portage on this account, for about one-half a mile. His notes give the date of this portage, but not the location. He would judge it was about half way between Dandy Crossing and Lees Ferry. (R. 1899.) This railroad was to be located along the side of the bed of the river. (R. 1899–1900.)

As he recalls, Mr. Stanton picked up his survey line about half way between Tickaboo Bar and Lees Ferry. The line had been run down the year before. He recalls that they were stuck on sand bars several times. He states that the lower river is more gravel; there is sand, too, but a good deal of fine gravel. When they would get on a bar they

would get out of the boats and push them along, or take them back and hunt for another place, some times taking a shovel, stirring up the gravel and sand, and letting the current wash them through. He remembers one instance where a dike or stone ledge goes across the river, and one of the men took a shovel and crossed it. Waded clear across the river to see if he could find an opening for our boats to go through. (R. 1900.) From Crescent Creek down to Lees Ferry he saw possibly eight or ten people, outside of the party from Omaha. These people were engaged in placer mining. One of them was Jack Sumner, one of Powell's original men.

There was no machinery there, except at Tickaboo Bar, where he saw a thirty or forty horsepower pump. He didn't know to whom it belonged but knew that Mr. Stanton was interested in it. All of the members of the party staked out placer claims but he never followed the placer claims up. (R. 1901.)

He doesn't believe there was a post office at Hite at that time but mail would come in from Hanksville with travellers. He doesn't recall getting any mail there but does recall a post office at Lees Ferry, where he got mail. They also received supplies at Lees Ferry that came in from Kanab or Johnson, Utah, by wagon.

The next time he saw Glen Canyon was in 1891, when he was with a prospecting and mining com-

pany, called the Denver, Colorado Canyon, Mining and Improvement Company. He came down the Green and Colorado Rivers, from Greenriver, Utah. (R. 1902.) Eight in the party. J. D. Best was in charge; Harry McDonald was the head boatman; Elmer Kane, boatman; L. H. Jewel, boatman; McCormick, photographer; John Jacobs, boatman; John Hyslop, engineer, and himself, boatman. Mr. Hyslop and Mr. Kane had been with him on the second Stanton expedition, also Mr. McDonald. Mr. Best when he got acquainted with him was in the real estate business in Denver, and they organized this company, partially through information received from Mr. McDonald. That company was known as the Grand Canyon Mining Company. There was a lost mine in the lower part of the Grand Canyon—that is, there was supposed to have been one down there, and this was a trip for placer mining and general prospecting. (R. 1902–1903.) This expedition was intending to go down clear through the same as Stanton, to tidewater, the gulf of California. He (Edwards) went through to there. The survey was just a reconnaissance more of a photograph survey from Lees Ferry on. No lines were run after they left Lees Ferry, just simply reconnaissance with the photographers taking the views, to show the characteristics of the canyon.

The Best expedition left Greenriver, Utah, about July 10. The equipment consisted of two boats,

practically the same as the Stanton expedition. They were twenty-two feet long, four and a half foot beam, thirty-two inches deep, keel boats, air-tight compartments, water-tight compartments in the end and for the hatches—for the supplies. (R. 1904–1905.)

They left Greenriver in the morning and dropped down about five miles to what was called Devil's Auger, quite rough at that stage of water. (R. 1905.) From there on down to the mouth of the San Rafael, or what was known at that time as Wheeler's ranch, they encountered riffles. The river bed was mostly of a rock formation, boulders and rocks all through the channel. (R. 1905.) They also grounded some, but not bad. When they arrived at Wheeler's ranch they decided it wouldn't be safe to take all the provisions through Cataract Canyon, and they made arrangements with the Wheeler brothers to take a load by wagon to Dandy Crossing. (R. 1906–1907.) From there on they passed through Labyrinth and Stillwater Canyons, where the creek crosses back and forth. It is pretty hard to tell where it crosses, and they were on sand bars quite a lot. In that stretch of the river through Labyrinth and Stillwater canyons, their boats grounded on sand bars but not as frequently as he did on the later trip down there, on account of the water conditions. But we were on sand bars plenty. Got off these sand bars by getting out and waded, or push off with the oars,

or rock the boats, any way they could. From the mouth of the Green River to the head of the cataracts, did not experience any difficulty in there.

In Cataract Canyon they started in at the upper end with eight men and two boats, and came out at the lower end with eight men and one boat.

In No. 13 rapid—the rapids of Cataract canyon are rock rapids, caused by the wash from the side canyons that comes in and washes the boulders and rocks out into the river, forming dams, what we call dams; then that backs the water up, makes a smooth place above, then you have your fall, then your heavy waves at the bottom—in No. 13 rapid, No. 13, which we reached on the second day from the first camp we made on the Colorado—we generally got out when we would get to these rapids, to examine them and try to pick out the best channel we could pick; with the style of boats we had, we couldn't go down the river backwards; we had to get out in the current and get the boats to go faster than the water, in order to get steerage way, which you would have to do with any large boat, if you wanted to go through a place like that. They would get out, the oarsmen would pull as hard as they could to get the boat going faster than the water; then we had a chance to dodge these rocks or these bad places in the river, and get through. The first boat started out, got about half-way down this rapid, and saw they weren't going to get in the channel, tried to pull

ashore; they lost control of the boat and ran against one of these big boulders in the river, and the boat and the four men went down. This expedition was equipped with life preservers. They were cork, warranted to float ninety pounds dead weight.

Cataract Canyon is forty-one miles long; they counted over fifty rapids. Did not run all the rapids. They lined the one where they lost the boat and portaged one. Ran the rest; portaged the provisions several places and ran the rapids with the empty boats.

Between Greenriver, Utah, and the end of Cataract Canyon did not meet any other boats. Saw no people except the Wheeler boys. (R. 1907–1909.)

They wore the life preservers coming down through Cataract Canyon; and they wore them when on the river; never went on the river without the jackets on, for the protection in making portages and lining boats; they felt they would have something to protect them from the rocks. (R. 1910.) From the end of Cataract Canyon on down to Hite, Utah, there are one or two bad rapids in Narrow Canyon, nothing serious, but what they got through, but got pretty wet. (R. 1910.)

After they lost the boat in Cataract Canyon the balance of the party walked where they could. They ferried them across from one bank to the other until they came to Narrow Canyon, where they all had to go part way through, all eight men in the boat. (R. 1910.)

It was at this point that they found marked in the wall: "D. Julien, 3 May, 1836." He saw this "D. Julien" writing at three different points; two places on the Green River, and once on the Colorado. He didn't know just where it was located on the Green River, but it was below Bowknot. On the Green River it was on the bottom land, but on the Colorado River it was in such a place that could only have been put there by somebody on a raft or in a boat. The inscription had been made with some kind of a sharp instrument. [Compl. Exhibit No. 23.] (R. 1911.) At the "D. Julien" inscription the water ran right under the edge of the cliff, and could only have been reached by a man on a boat or a raft.

They then continued on down to Hite, Utah, some of the party walking and the rest riding. After they got to Hite, they picked up a flat-bottomed boat and repaired it. The eight men then continued with the flat-bottomed boat and the good boat to Lees Ferry, where they abandoned the river. They were resupplied at Hite with supplies brought in by the Wheeler brothers, who were there when the expedition arrived. (R. 1912.) The Wheeler brothers also brought a little mail. There was no post office at Hite at that time.

From Narrow Canyon down to the place where he picked up the boat it was characteristic of the river to be swift in places, with riffles, what he would call a small rapid. He doesn't remember

encountering any sand bars or crossing bars that far up in the river. (R. 1913.) It was not possible, because of the shape of the boat, to go stern foremost through the rapids, for the reason that what they call a round-bottomed keel boat, as long as it is going fast, can be steered, but as quick as it stops control is lost. (R. 1913.)

From Hite, Utah, the river had fallen, as it was then about the first of August. They stopped on a great many bars and staked out more [placer] claims, as they did the year before, and both boats would run on the gravel beds and bars and get hung up. If they couldn't push them through they would dig them through. This continued on down the river until they got about twenty miles above Lees Ferry. After they reached Lees Ferry he and two other men returned to Denver. Messrs. McDonald, Kane, Hyslop, and Best got a pack outfit, went down on the Buckskin Mountains, down into the canyon to look for the lost mine, and he didn't see them any more. (R. 1913–1914.)

He took a wagon and went from Lees Ferry to Johnson [Utah], then on to the Rio Grande Western Railroad, then to Salt Lake, and back to Denver. The town of Johnson, Utah, is located about eight or ten miles east of Kanab, Utah. He didn't go to Kanab on that trip. On both his trips to Lees Ferry, Mr. Thomas Johnson was living there, and one other man by the name of Huntington. He couldn't say whether there was any difference

in the channel of the river through Glen Canyon between his first and second trips, or as to whether or not the sand bars were located in the same place. The road from Lees Ferry to Johnson City was just a kind of a trail road, a distance of about ninety miles. They made the trip with a team and spring wagon. He believes that it must be about two hundred and fifty miles—something like that—from Lees Ferry to the railroad. (R. 1915–1916.)

He made another trip down the Colorado River in the spring of 1893. He was in charge of this expedition. He thought that there were a lot of tourists who would like to see the Colorado River from the upper end and, as he had recently been down in that country, he thought it would be possible to operate a boat down from Greenriver to the junction of the Green and the Colorado Rivers, and take tourists down there.

Previous to this time some parties from Salt Lake and Rawlings, Wyoming, had shipped a steam launch into [Greenriver, Utah] from Chicago, which had been launched, run down as far as the Wheeler ranch and abandoned. He leased that boat and made an attempt to see what he could do with the river. (R. 1916–1917.)

This boat was known as the *Major Powell,* and he believes was about thirty-five feet long, with an eight-foot beam, equipped with an upright boiler with two six-horse engines, connected to twin screws, and drew about eighteen inches. (R. 1916.) This boat had been laying there for a year

or more, and when he came over to Greenriver, he got a small boat and went down to the Wheeler ranch in February or the first of March. He came part way by water and part way by ice, as the river was still frozen over at that time. (R. 1917.)

The boat that he had was a little skiff, and he dragged it over the ice until he got down there. He examined the *Major Powell* to see what would have to be done with it, and then he returned to Denver. He hauled the small boat back to Greenriver by wagon. In Denver he got a friend of his, an old lake marine engineer, secured the necessary material to repair the boat, and he and the marine engineer and one other man returned to Greenriver, repaired the boat, and started down the river The boat had been tied up on the shore above the water. They put the boat in the river, got up stream, and everything was in good shape. They started down the Green River from Wheelers ranch, located about twenty-five miles below the Greenriver railroad bridge. (R. 1918.)

Besides himself there were H. F. Howard, now dead, and a man named Graham. He doesn't know what became of Graham. The boat had originally been built to burn coal oil; he changed it over to burn wood, and spent a good many hours of hard work cutting wood for the boat. They would run as far as they could with a load of wood and then cut another load, and do the same thing over and over. (R. 1919.)

On the first trip down he tried to mark the channel as near as possible, so that when he returned he would have something to work on. He would leave marks on the rocks at the turns, so he could tell what direction to go.

He didn't mark all of the river, only the places where there were bad bars, where they had lots of trouble; but "the marks didn't do any good. When we came back the channel wasn't where it was when we went down." (R. 1919–1920.)

On the way down the river experienced plenty of difficulty with sand bars. To get off them would sometimes pull off with a block and tackle; sometimes dig it out; various ways we would work it. Sometimes we would come to places we couldn't get through, and we would reverse the boat, back down, and run the propellers backwards and tear out the sand and get through that way. This was in March or April; didn't get started until about April the first trip. Used block and tackle by making it fast to something on the shore and then pulling. Had no capstan. Used main strength. This sand-bar trouble continued all the way to the junction. Turned around at about a quarter of a mile above the first rapid in the Colorado River. The trip up the stream was not quite as hard as it was going down because we would have the chance to back off the bars and try other places; but it took about ten times as much wood coming up as it did to go down.

The lake captain suggested while going downstream to mark the channel, which they did, but did not get any results from those markings because the channel had changed before they got back. The water had risen. The *Major Powell* got up as far as the Wheeler ranch. Did not attempt any farther up because he didn't think it possible to get it up there; too much rock and rough water. (R. 1920–1922.)

He made a second trip down the Green River about ten days after the one just described. On this second trip they had a little better help. Besides himself and Mr. Howard, there was Mr. McClane, Mr. McDonald, and Lute Johnson. Mr. McDonald was a different man then from the one on the San Rafael expedition. (R. 1922.) On the second trip they carried more fuel, except wood, and went down the river to about the same place he went to on the first trip. It took them about three weeks to make the round trip, about evenly divided going down and coming back. On the second trip the river had begun to rise a little. (R. 1923.) The river was quite a little higher, but it shifted the bars so the information they tried to have on the first trip didn't do them much good on the second; had to go through all the preliminaries of finding channel on the second the same as the first. It took them about as long to make that second trip as it did the first. Made the same distance exactly. Coming up the river had about the

same trouble as they did on the first trip; had quite serious trouble getting out of the Colorado. The Grand River had had some flood that had gone down just a little too far, and their boat wasn't strong enough to pull them out of there; the only way they could get out of there was by use of a block and tackle, lining along the shore. Did not get the boat up to Greenriver, Utah. Left it at Wheeler's ranch on the second trip. Tied it up there. (R. 1923–1924.)

In 1894 he was over on the Green River with a mining company, about seven or eight miles below the bridge on the Green River, and while he was there four fellows brought the boat *Major Powell* to his camp and abandoned it. (R. 1924.) This was at a point fifteen miles above the Wheelers Ranch. They took the engine and boilers off the boat, and took them to Greenriver. He believes the hulk went down the river. (R. 1925.) The Rio Grande Western Railroad Company was in a way interested in this boating venture, as it was through the young Mr. Dodge that the trip was undertaken, and while they didn't finance the trip, they furnished transportation and did everything they could to help.

On the second trip Mr. Lute Johnson accompanied the expedition, as he was a newspaper man, and they hoped to have publicity when they got the boat going. (R. 1925.)

Between the Best Expedition and the first trip of the *Major Powell* he went in on the San Juan

River, during the placer mining boom of 1892. He left the railroad at Greenriver, Utah, had a pack train of horses and mules and went through Hanksville to Hite, across the Colorado River, up White Canyon, and south to the San Juan River about forty miles below Bluff. He was hired to make this trip by the Rio Grande Western Railroad. (R. 1925–1926.)

When he left the San Juan River, he came back north to Red Canyon and to the Colorado River. He was accompanied by an engineer from the railroad company; they picked up an old boat and went down the Colorado River fifteen or twenty miles, then towed the boat back up to where they had left their pack animals across the river, and returned to Greenriver, Utah, by the way of Hanksville. He followed the same route from Greenriver, Utah, to Hanksville, as he had done with the second Stanton Expedition, and he didn't see any change in the country as to population. He didn't see very many people. From Hanksville to the Colorado River on that trip, he went down the next canyon south of Crescent Creek [North Wash], which brought them right down to Hite, but he doesn't know the name of the creek [Trachyte Creek]. (R. 1926–1927.) Hite and Dandy Crossing are the same. He crossed at Dandy Crossing and believes it was in December, 1892, or January, 1893. He didn't have to swim his stock across the river at this point, as they

waded across. He saw no placer miners on the Colorado River.

After they crossed they followed a trail up White Canyon to its head, then cut across south until they struck the San Juan River. (R. 1928.)

When he left the San Juan River the boom had broken and the miners had all gone. He didn't see anything at all in the way of works or mining expeditions; didn't stake out any claims or try to wash out any gold; he didn't see any boats on the San Juan River, or meet any people on the east side of the Colorado River.

On the return trip, when he came to the mouth of Red Canyon on the Colorado River, he got the boat and went down some fifteen miles to a placer mine, where he expected to find people, but there was no one there. He could see where they had worked; mostly with rockers. He saw no other boats on the Colorado River besides the one he found.

After he towed this boat up stream, he believes they used the boat to carry their stuff across and doesn't remember how he got the stock across. They crossed at Good Hope Bar. He simply left the boat there and followed a trail up to Dandy Crossing. He was accompanied on this trip by a Rio Grande Railroad engineer, named Green, who had charge of the party; Cy Warman, who wrote "Sweet Marie"; and two others. (R. 1930–1931.)

After the party crossed the Colorado River on the return trip, they went back to Hanksville and

then to Greenriver, Utah. The Hanksville trail was the main trail from Greenriver to Dandy Crossing. Hanksville was the only habitation on the trail. (R. 1930–1931.)

He only stayed over night on the San Juan River and didn't cross the stream. He remembers there was very little water in it; not more than two or three feet wide and possibly a foot deep. This completed his experience on the river. He has been on the lower Colorado, but has never been back to the upper river since the San Juan trip, with one exception, when he went back about 1895 with a placer-mining outfit.

On this trip he went about eight miles below the bridge at Greenriver to put in an amalgamator. It was a dry-land dredge, a steam shovel, run electrically. The outfit would handle about a yard of gravel a minute. They brought machinery down the river by wagon, came down on the west side, and crossed the river with it. The machinery weighed one hundred tons. They forded the river, he believes, in September or October, and stayed in the country for about a year. (R. 1932–1933.)

He operated the dredge nearly every day, and during this time he saw two outfits come down the Green River: One, Mr. Galloway and his partner, who were bound through the canyon; and the other was Flavell and Richards. He employed about twenty men on the trip, and brought the supplies in overland from Greenriver. After this work with the dredge he returned to Colorado.

(R. 1934.) The dredge was abandoned. It was finally sold and moved to Idaho. It worked in there about a year.

Took several months to get it in there and get it in operation; then winter came, it got pretty cold, had to kind of lay off until spring before we could do anything. It had a boiler—two one hundred-horsepower boilers—steam engine, electric generator. This dredge was run by motors. Used coal—five or six or eight tons a day of coal. Coal was brought in by wagon from Greenriver, Utah. Was operating on the east side of the river. Coal forded across the river at the mill. Teams hauled it down from Greenriver opposite our camp, and crossed the river there on the ford, put it in our bin. (R. 1935–1936.)

Cross-examination (R. Vol. 10, pp. 1936–1945; R. Vol. 11, pp. 1948–1957.):

The mill was located about eight miles below the bridge at Greenriver, on dry land, on a gravel bar, above the high-water mark. (R. 1936–1937.)

None of the operations extended into the river. He knows that the machinery came from Denver, and at the town of Greenriver it was unloaded from cars into a wagon, and hauled down under contract over a fair desert road right to the job. He believes the coal used came from the Carbon County Coal Mines and shipped in to Greenriver on the railroad. (R. 1937.)

At the time he went down on the San Juan River he couldn't state exactly the location, but it was

twenty or twenty-five miles below Bluff, somewhere between Bluff and where the canyon boxes up. He feels sure he got there in the afternoon. He didn't make any investigation of any kind but believes the engineers checked it over. He was the cook and guide for the party, and they went down in December and out in January. (R. 1937, 1938.) It was early in January when they stayed over night on the San Juan River, but he doesn't remember whether there was snow or ice on the ground. He does recall that there was plenty of snow on the way home. With respect to the San Juan River he recalls that there was open water in the stream, which he judged to be about a foot deep. (R. 1939.)

If the water extended out under the ice, he wouldn't know how far. He knows he forded the river going over at Dandy Crossing. He believes one of the men rode a horse, and led the rest. He doesn't recall whether he rode a horse, or went by boat. (R. 1939, 1940.) Didn't walk across. (R. 1940.) He recalls that he went on an expedition down the Colorado, for about fifteen miles, in a small boat, using oars; and he believes he was gone about four days. (R. 1941.) While down the river on that trip he did some prospecting, but did not stake out any claims. (R. 1941, 1942.) Probably rowed up river some, and towed. (R. 1942.)

He remembers that on the San Juan Expedition in 1889, Mr. Nims was along. He also remembers that this expedition picked up the [survey] line

before the expedition reached Lees Ferry. (R. 1942.) He remembers they came upstream three or four miles with one of the boats on the finish, and it took them all day to get up where the instruments were and get back. The line had been run along from day to day, they got close to Lees Ferry, and went on in to that place because they wanted to get something to eat. He kept notes on this trip, and has them with him. He is referring to the second Stanton Expedition. (R. 1942, 1943.) He remembers Mr. Nims very well. (R. 1944.) At that time he was acting as a boatman, and it was afterwards he had to take over the cooking as a side line. (R. 1945.)

When going downstream in rowboats on all of the expedition that he had testified to, when he was pulling downstream he would be facing upstream; but part of the time he steered with an oar in an oarlock at the rear end of the boat, and when he occupied a position like that he would face downstream. (Vol. 11. R. 1948.)

The purpose of the 1891 trip was to locate a lost mine that was supposed to be in the lower canyon near Bright Angel, somewhere in the Kaibab Forest on the north rim. (R. 1948-1949.) They had other interests besides the lost mine, but that was their ultimate goal. It was their intention to prospect the whole canyon all the way down and they expected to be there for a year or more, but they went more or less directly to the Cataracts, and did

no prospecting along the Green River as they went down, nor on the Colorado until they reached Cataract Canyon. (R. 1949–1950.) He didn't personally make the plans; he was simply working for the company and whatever they wished done, he did to the best of his ability. He knew enough about the purpose of the expedition to know they were to go down the canyon of the Colorado River below Cataract Canyon, prospect from there on down to Bright Angel, and then try to locate the lost mine. (R. 1950.) The men in the party who had made the trip before this, besides himself, were Mr. Kane and Mr. McDonald. Mr. McDonald was the head boatman, and Kane was also a boatman. The engineer of the party was John Hyslop; and the entire party was in charge of J. S. Best. Mr. Best had not been through before, but Mr. Hyslop had been with Mr. Stanton. They talked fully of their experiences on the river. (R. 1951.) He recalls making fifty or sixty marks so he could remember where the channel was [on the trip down the Green River, in the boat named *Major Powell*]. These marks were made on rock with paint which had been left over after the boat was painted. (R. 1952.) In coming back upstream they found that the channel had changed in a dozen places or more. He recalls they were gone about three weeks on this trip, and believes the date was in April. They came back in the same month, but on the return trip there had been a rise in the river. (R. 1953.)

Then when he went down in May, there were some places where the channel was similar, but there was quite a little change in the river. (R. 1953–1954.) Every trip they made, the channel was different in places. He found that channel was different from the other channels; there had been change in the water; they like not to have got out of the Colorado River at all on account of the high water. (A. 1954–1955.) Found more difference between the first trip down and the second trip down. Could not say how many places found stable channel. Expect found it same in great many places, but he does not know that they did, because if anybody can track that river up and down at the same place twice in succession they could do better than he could. It is rather difficult. (R. 1955–1956.)

He had written notes at the time, but they were lost. He can not give an estimate as to the number of places where the channel had changed from where it was when he marked its location on the rocks with paint. (R. 1956–1957.)

Redirect examination (R. Vol. 11, pp. 1958–1974):

He never observed any sand waves on either the Green or Colorado Rivers on any of the trips and never heard of any permits being granted by the Federal Government for placer-mining operations. (R. 1958.)

The dredge he was operating below Greenriver was right on the edge of the river itself, but on a

bar sufficiently high so that ordinary high water would not reach it. When he was operating the boat *Major Powell* he never operated it at night. The draft of the *Major Powell* was about eighteen inches, loaded. (R. 1959.)

Compl. Exh. No. 222 shows the boats of the Best Expedition at Greenriver, Utah, and the rope that appears to be looped around the boat is a life line. The picture was taken just above the bridge at Greenriver.

Compl. Exh. No. 223 was taken just below the bridge at Greenriver. (R. 1960.)

Compl. Exh. No. 224, just below the bridge at Greenriver, at Browns ranch, shows a water wheel to raise water for irrigation, and is on the left bank, going down.

Compl. Exh. No. 225, he believes, was taken at Stillwater canyon.

Compl. Exh. No. 226, and Compl. Exh. No. 227, were taken at Bowknot Bend.

Compl. Exh. No. 228 was also taken at Bowknot Bend.

Compl. Exh. No. 229, on the other side of Bowknot.

Compl. Exh. No. 230, shows Cross Buttes on the Standing Rock Park, he believes below Stillwater. [Canyon, on the Green River.] (R. 1961–1962.)

Compl. Exh. No. 231, at Cross Buttes.

Compl. Exh. No. 232, at Buttes Park, on the Green River.

Compl. Exh. No. 233, at Aztec Fort, on the Aztec bottom, down below Bowknot Bar, where the Aztec Indians had farmed by irrigation. The ditch was about sixty feet above sea level. (R. 1962.) Aztec Fort is about one-half mile back from the river, at a point where the river makes a back turn, and the fort is on a high point between the bends. He saw four of these ancient buildings at this point on both the Green and Colorado Rivers. There were no Indians living there at that time, as they were the remains of the Aztec People, the cliff dwellers. He could see where they had farmed a small flat, of possibly a couple of hundred acres on the river bottom. He could trace out the lines of their ditches and their laterals, but there was no sign of how the Indians got there and no trail that he knew of, or saw. (R. 1962–1963.)

Compl. Exh. No. 234 shows the junction of the Grand [Colorado River] and the Green. (R. 1964.)

Compl. Exh. No. 235, looking down the Colorado River from near the junction in Cataract canyon. (R. 1964.)

Compl. Exh. No. 236 shows rapid No. 13, in Cataract Canyon on the Colorado River. The rope shown is fastened to the boat under the rock; it is the point at which the expedition lost a boat.

Compl. Exh. No. 237 is the same thing, only had a rise in the river that pretty near submerged the rock. About 3 or 4 days intervened between the time of those two pictures; the water was higher in the taking of the second picture. (R. 1965.)

Compl. Exh. No. 238 again shows rapid No. 13; a man going out on a rock on a rope, and another man on the rock.

Compl. Exh. No. 239 shows the other boat in shore, and two men out on the rock; the same rapid No. 13.

Compl. Exh. No. 240 shows the same thing, with a man in the water, going over on the rope; the man in the water is either Kane or McDonald.

Compl. Exh. No. 241 shows the men who were in the boat when it went down, dressed in their customary equipment. (R. 1966, 1967.)

He was then handed Compl. Exh. Nos. 242 to 262 and stated that these were the remaining pictures of the Best Expedition.

Compl. Exh. No. 242 is looking down from the top of Cataract Canyon to the river; and shows rapids Nos. 13 to 22, inclusive. The picture shows the same rocks as are shown in Compl. Exh. Nos. 236 to 238, inclusive. It was taken from the rim, looking down.

Compl. Exh. No. 243 shows rapid No. 36 in Cataract Canyon. The boat No. 2 is in the rapid.

Compl. Exh. No. 244 shows rapid No. 35 in Cataract Canyon.

Compl. Exh. No. 245 shows D. Julien's Point in Cataract Canyon. (R. 1967.) The "D. Julien" inscription appears on the right side of the picture, as you look at it, at about three-quarters of an inch up from the water. It might be submerged at high water.

Compl. Exh. No. 246 shows Mill Craig Bend in Cataract Canyon.

Compl. Exh. No. 247 shows the only rapid in Cataract Canyon that the expedition portaged. They called in the Big Rock Rapid, No. 25. (R. 1967–1969.)

Compl. Exh. No. 248 shows Cranberry Point, Cataract Canyon. (R. 1969.) The trees in foreground are Cottonwood. When Stanton's party went through in 1889, across the river from here (indicating) they found a half barrel of cut loaf sugar. While they were camped here they crossed to see if they could find any of it. Digging around in the sand they found a case of a dozen quart jars of cranberry jam. The date on the box said it had been put up in 1836. Broke several of the jars, and took the balance back to camp, and found it a welcome addition to our fare. Also found the remains of a wagon box, and the bone of a human leg at the same point. Named it Cranberry Point. In foreground is flat plain of river. River is to left in Compl. Exh. 248. (R. 1969–1970.)

Compl. Exh. No. 249 shows the lower part of Cataract Canyon, and Exhibit No. 250 was taken just above the mouth of the Dirty Devil, or Freemont River. (R. 1970–1971.) The mouth of the Dirty Devil is shown by a cross on the photograph, which also shows a boat with all seven men in it. The picture was taken after they lost the first boat.

Compl. Exh. No. 251 was taken in Glen Canyon, below Hite, and shows two channels and a sand bar in the river. (R. 1971.)

Compl. Exh. No. 252 is also taken in the Glen Canyon, but he doesn't know the exact point. (R. 1971–1972.)

Compl. Exh. No. 253 shows Dandy Crossing Camp, the tall man in the boat being Mr. Best, and another, Mr. Kane.

Compl. Exh. No. 254 shows fish caught in the Colorado River, and he saw the head of one that weighed eighty pounds. (R. 1972.)

Compl. Exh. No. 255, he believes, was the camp on Tickaboo Bar. [near Hite.]

Compl. Exh. No. 256, the same as Exhibit No. 255.

Compl. Exh. No. 257, shows the flume where they put the water on Good Hope Bar for mining purposes.

Compl. Exh. No. 258 is an extension of Exhibit No. 257, and shows the water wheel and flume.

Compl. Exh. No. 259 is somewhere in Glen Canyon, between Dandy Crossing and Lees Ferry. (R. 1973.)

Compl. Exh. No. 260 shows the mouth of Paria Creek at Lees Ferry, and also the John D. Lee stone fort on the Colorado River.

Compl. Exh. No. 261 shows the Johnson ranch at Lees Ferry. Paria Creek is shown in the fore-

ground, and is where they got their water for irrigation.

Compl. Exh. No. 262 shows fruits and vegetables grown on the Warren Johnson farm at Lees Ferry.

Recross-examination (R. Vol. 11, pp. 1974–1977):

That is the ferryboat; here [indicating] (Compl. Exh. 222) is the cable. That ferryboat was there in operation when he arrived there. (R. 1974–1975.)

A great many pictures were taken of the stream down through Glen and Stillwater Canyons [on the Colorado and Green Rivers], but after the pictures were returned to Denver they were not developed and the negatives stayed there for about twelve years. They had been opened, some had been exposed to the light, and about three hundred of them had been ruined. Just a few were picked out at different points to see what they looked like. (R. 1975.) The men in the boat wrecked at Rapid No. 13 walked from there some distance. They had to walk, because we couldn't carry them. The canyon walls come right in close to the river; no chance to get by; box canyon in the lower canyon. (R. 1976–1977.)

Further examination (R. Vol. 11, pp. 1977–1979):

From Hite down to the mouth of the San Juan River, one can walk along the bank quite a good bit of that distance; there is a trail from Hite to

Good Hope bar; he doesn't know whether it goes any further or not. It would depend considerably on the stage of the water. He doubts if a horse could tow a boat up.

The *Major Powell* was a boat thirty-five feet long, with two six-horsepower steam engines. In his opinion that is not sufficient horsepower to utilize on that river. If he had had more horsepower he could have come up the river there better. Current of the river was the principal trouble.

If he had had sufficient horsepower he could have overcome that, of course.

We saw signs of ancient Indian habitations the entire journey from Greenriver to the mouth of the Grand wash opening out to the Grand Canyon of the Colorado. They were signs of what is claimed to be the cliff dweller Indians. By signs he means they found their houses, their granaries, where they stored their food; found corn, found the remains of their houses. In those found corn tassels, the tops of corn that had been wrapped up with a willow wythe and stored, he supposes, for goat feed. Found bones from animals; utensils that they used one way or the other. Found traces of these cliff dwellers all way down Green River, and on the Colorado; a good many of the places they were in the side canyons that opened in on to the river; some of them wouldn't be on the river proper, but on the side canyons. And there were no evidence that those were of recent date or occupation. (R. 1977–1979.)

Recross-examination (R. Vol. 11, pp. 1979–1981):

In his trips through the canyons he did not come in contact with any of the Navajo Indians; we saw one or two at Lees Ferry, is all. Saw some Indians after they came out of the Grand Canyon, way down on the lower river. Not Navajo Indians, though.

He has heard of the Indian legend, if it is a legend with the Indians, to the effect that the Navajos ran their enemies into the Colorado River, into those canyons there, where they turned into fish. And that the Indians were afraid to go in there on the rivers, on the Colorado, because they believed that the enemies of their race were turned into fish and would destroy or kill them if they go there. He does not know that that is the belief of the Indians in that section of the country.

The earlier race of Indians that were supposed to have been driven into the river, it is claimed, were the Aztecs. (R. 1979–1981.)

Recalled (Vol. 11, pp. 2036):

On trips on Green and Colorado down to Lees Ferry, Mr. Stanton had information Mr. Powell had; had topographic map of Powell expedition; gave orders from the maps. On Best expedition, does not think any map or survey used. (R. 2036.)

ELMER KANE

For Complainant

(Record, Vol. 11, pp. 1982–2035)

Resides in Los Angeles, California; 66 years old; has had considerable experience with boats. (R. 1982.)

Been on Colorado almost its entire length prospecting. Fall of 1899 was on Green and Grand Rivers. Generally with pack horses and saddle horses. On upper river, used just small flat-bottom, light rowboats; not much water, rocky and shallow.

In summer of 1888 went from Grand Junction down Colorado River on a common raft; Emerson and Duke with him on trip. (R. 1894.)

He has placer mined upriver from Moab in the La Sal and Blue Mountains. Came down to Moab, but could not get a boat there to complete trip. (R. 1986.) Miners at north end of Blue Mountains on Colorado had a flat-bottomed skiff they used; going down from Grand Junction saw a ferryboat there and three small rowboats used to cross back and forth.

Tried to get with the Brown-Stanton party but missed them. Brown-Stanton party returned in July, after Mr. Brown's death. (R. 1988.) The Stanton boats were of the same as description given by Mr. Edwards. (R. 1989.)

They left Denver November 28, in cold weather. Boats were hauled overland to Crescent Wash. (R.

1989–1990.) Left camp on Crescent Creek 6th or 10th of December. Kept diary of trip. (R. 1990.) Practiced rowing after boats were in water; Langdon Gibson and brother C. D. Gibson, fine oarsmen and champion rowers. (R. 1991.)

Mr. Stanton's boat led expedition. Oars were extra long; boats overloaded, heavy and hard to pull. (R. 1992.) Sat with their feet in sort of stirrups, so boat rolling would not throw them out.

Between Crescent Creek and Hite encountered a great many small rapids, winding rapids; full of boulders; run on banks, run on to bars. Everybody would get out and wade across river back and forth to find channel; some places get through all right, some places have to drag boats; same conditions every few miles, all way through Glen Canyon, the upper canyons, above Cataract Canyon, and through Green River. (R. 1993–1994.) Stopped at Hite several days. (R. 1994.) Party there to meet Mr. Stanton in connection with mining, came by horseback or wagon to Hite. (R. 1995.)

Between Hite and Lees Ferry there are rapids; all the rapids are at the mouth of side washes that carry out rocks into river in storms, high water, floods, and cloudbursts. River either coming up or falling all the time; every day is different. Very little time in summer that it is not changing; rising or falling. (R. 1995–1996.) The great trouble with Cass Hite's mining he never could keep in a

flume. The river would get too high and wash away his flumes and trestles. (R. 1996–1997.)

Arrived at Lees Ferry December 23d. Ranch house at Lees Ferry, man and family living there. Al Huntington had headquarters there. (R. 1997.)

He measured quite a number of side canyons. (R. 1998.) Took altogether 1,700 pictures. (R. 1998–1999.) Expedition continued to Gulf of California. (R. 1999.) Mr. Nims broke leg and fractured skull; taken to Lees Ferry. (R. 1999.) Party resupplied at Lees Ferry. Lost a boat in Grand Canyon. Some of party went out at Pete Spring. Supplies came to Lees Ferry overland from Kanab. (R. 1999.)

Boats carried 1,600 or 1,700 pounds of supplies. Space between keel and floor filled with canned goods. Figured to make 5 miles a day and provisions to carry twelve men to Diamond Creek. (R. 2000.) Did not make 5 miles a day, many days not over half a mile; lost a boat with provisions; lost provisions out of another boat. Boats were lost below Lees Ferry.

Best Expedition, left Greenriver on 4th of July, 1891. (R. 2001.) Boats as described by Mr. Edwards. Supplies taken to last until reaching Lees Ferry. (R. 2001–2002.) Landed at Lees Ferry on August 29th. (R. 1991.) Made prospecting expedition in Glen Canyon.

From Greenriver to mouth of Green River, bothered a good deal with shallow water; it made

delays and hard work; encountered a good many channels, scattered out; got stuck on bars, looked for deeper water. (R. 2003.)

Mr. McDonald was previously on Green River with Brown-Stanton party.

Between Greenriver and mouth of San Rafael; riffles pretty swift; strong swift current carried them along, bumping and grinding. (R. 2004.) Running on sand bars a frequent occurrence.

From mouth of Green River to head of Cataracts, 5 miles; swift water. (R. 2005.)

Cataract Canyon, ran a number of rapids; had trouble in No. 13; stopped at every rapid and went ahead to pick out channel. At Rapids No. 13, boat struck on rock, current carried boat sideways into rock; boat in swift water turns up flatways. (R. 2006.)

When boat struck, struck on point of rock; stopped, swift water washed them over; Best and Mac jumped onto rock; Jewell and Kane were washed out of boat and went down through rapids. Had cork jackets on; Jewell got in eddy and was carried to shore. (R. 2007.) Witness went over a mile down before he landed. Boat stayed on rock for twelve days. In fast water in canyons have to make flying landings. Tied long line on boat; grapple hooks on short throwing line; small blocks and tackles; connected and tried to pull boat loose; broke a ¾-inch line with men pulling. (R. 2009.) Tried gin poles; tried to saw boat out; Mr. Hyslop

went to Dandy Crossing for dynamite. (R. 2010.) Before he returned, water rose and covered boat; it was abandoned. (R. 2011.) Crew of wrecked boat walked along shore, crossing in boat to other side of river in the places cliffs came down to river. (R. 2012.)

Through Cataract Canyon provisions and equipment were portaged around rapids. (R. 2012.) From end of Cataract Canyon down to Lees Ferry, pretty good water; one rapid in Dark Canyon, couple of pretty rough ones in Narrow Canyon. (R. 2013.) Glen Canyon, not so many rapids; nothing as bad as Cataract. Went through in August, more water than previous December. Rapids in Glen Canyon due to shallow water; Tickaboo Rapid, swift and shallow. (R. 2013–2014.) Men and supplies ran rapids; when did not have to portage stuff did not call it a rapid, but it was shallow water. (R. 2015.) Trachyte Rapid was the worst; boats dragged several times. (R. 2015.)

In swift water you have to row to beat the current to steer the boat at all. (R. 2015.)

Sandbars in Glen Canyon, not so bad as in previous December; had more water. Shoved and hauled boats in Glen Canyon, below Tickaboo Bar. Made one portage half a mile long, sooner than pull and haul and lift the boats.

He walked across the river at that point. There are reefs, or ledges, where black volcanic rock are on both sides of and in the river, and run from

northeast to southwest along a big fault. It is a rock formation setting up in that country, and stretching entirely across the river. There are breaks in it from few feet, to 10 or 15 ft. (R. 2016–2017.)

Stayed at Lees Ferry six weeks; left boat there and walked to Kanab. Mail came to Lees Ferry twice a month by horseback from Flagstaff, Arizona, and Kanab, Utah. Flagstaff, 150 miles south; Kanab, 90 miles northwest. No mail came in on river.

Spent about a year and half in Grand Canyon country prospecting; went to gulf, returned back to Yuma in wagons, and back to Denver by railroad. (R. 2018–2020.)

Has never been back to Green or Colorado Rivers since. (R. 2021–2022.)

On second Stanton Expedition saw 20 men working at Hite and bars below. (R. 2022.)

Supplies received at Hite by Best expedition; hauled overland from Wheeler ranch. Saw no other boats on Green River while with Best expedition; saw no people. (R. 2023.)

Cross-examination (vol. 11, pp. 2023–2033):

1889 expedition, draft of boats 14 in. with men and load. (R. 2024.)

Boats of second Stanton Expedition, same draft boats used on 1891 Best Expedition.

Mr. Hyslop's trip overland for dynamite made in less than a week. (R. 2026.)

The reefs where the portage of half a mile was made ran parallel across river; nothing shifting or unstable about them. (R. 2028–2029.) Breaks where deeper channels, but did some shoveling in sand and gravel between and had to pull the boats. (R. 2029.) Pulled boats between the rocks. (R. 2030–31.) Would have trouble there if going up or down river; a little harder going up. (R. 2032.) Finding breaks in the reef would also depend on stage of water. (R. 2033.)

Redirect-examination (Vol. 11, pp. 2033–2034):

Raft trip from Cisco to Moab on Colorado River, used poles; pushed off rocks in many places; water shallow with rapids, reefs, gravel, and some sand. Raft 14 ft. long, 5 ft. wide, made of dry pine logs. (R. 2033–2034.)

Recross-examination (Vol. 11, pp. 2034–2035):

Mr. Nims present when portage made over the reefs. (R. 2034–2035.)

OTTO J. ZAHN

For Complainant

(Record, Vol. 11, pp. 2037–2062)

Resides at Los Angeles, California; 57 years old. First went into San Juan country in May, 1904, by trail to Dolores, to Bluff, and to camp by wagon. (R. 2037.) Camp located mile or two below Nokai Canyon; interested in placer mines. (R. 2038.)

No recollection of any other placer miners at that time, except man with him, John Gill. (R. 2038-39.) Supplies brought by freight wagon. (R. 2039.) (Zahn's Camp, Page 15, Compl. Exh. 10.) Equipment at camp had been freighted in year before by brother and others. (R. 2039–2041.) San Juan River that year was shallow, not over waist deep; waded across. (R. 2041.) Channel about 200 ft. Waist deep in main current. (R. 2041–2042.) Depth gradually lowered to 8 or 10 inches. Used water of San Juan in connection with mining operations. (R. 2042.) Operated in August when water very low. (R. 2043.) Sand and silt in water caused lot of difficulty by cutting packing of pumps. (R. 2044–2945.)

In 1905 went back on river; transported sluicing hopper on river; weighed 250 pounds; came by freight wagon to 15 miles above camp, to Recompense Camp; built a raft with drift timber, 12 or 14 ft. long, 5 or 6 ft. wide. (R. 2045–2046.) May or June, heavy flow of water coming down river; difficult to negotiate crossings; waited for water to subside, got caught and stuck on shallows; rode when channel open, waded when raft got stuck. Used rope to pull raft over into deep part; and to hold raft to steer around rocks by getting off and holding rope. (R. 2047–2048.)

Ditched entire flow of San Juan River, summer of 1904 over to pump for at least ten days. (R. 2050.)

Had one boat used to cross river. Never used boats to bring supplies down. (R. 2050–2051.)

Roads just natural roads, trails just like in any wild country, both north and south of river. No trail opposite Nokai Canyon; one going up Clay Hill divide, comes to river on other side of Copper Canyon. (R. 2052.)

In 1904 or 1905, no other people operating in San Juan Canyon. Never saw any placer miners using boats. Since 1905 all supplies and machinery taken in hauled by freight or automobiles. (R. 2052.)

Houses at camp up above flow of water six or seven feet; tight houses. (R. 2054–2055.) Camp partly wrecked two or three years before flood of 1911. First time camp partly buried. 3 ft. of sand in tool house. After flood of 1911 camp completely buried; just roof protruding out of sand. (R. 2055–2056.) Top of building 16 or 17 ft. above low-water level. (R. 2057.)

Seen sand waves on San Juan many times. (R. 2057–2058.)

1904 river nearly dry; summer freshets from side canyons, river so thick with mud, choked the fish. (R. 2058.)

Stage of water shifted main current from one side to the other; undermine sand banks. (R. 2059.) Swift current; has gone up river all way to Bluff sometimes on foot, sometimes on horseback. (R. 2060.)

No trails next to river in many places. Several camps above where he was located; at Moonlight; and at Cottonwoods. No agriculture down there; no persons engaged in agriculture. (R. 2061.)

Cross-examination (Vol. 11, pp. 2062–2067):

The Worthington pumps were 4-inch intake, 2½ inch discharge, one at bottom of river, one on top of bench; pumps would take 10% of the water so diverted. (R. 2064.) Diversion dam 10 inches high; only one channel in river at time of diversion. Not difficult job to divert the stream. (R. 2065.)

Believes the heavy rainfall completely burying the camp was in October, 1911. (R. 2068–2069.)

Redirect-examination (Vol. 11, pp. 2071–2072):

Placer locations were located under U. S. mining laws. (R. 2071–72.)

Recross-examination (Vol. 11, pp. 2072–2073):

Zahn Mining Company bought the claims; company dissolved long ago; still retains interest in properties. (R. 2071–72–73.)

Recalled (Vol. 11, pp. 2091–2093.)

Further cross-examination:

According to his recollection dry condition of the San Juan River when he diverted the water was in 1904. That was his first year there. Left in June same year. He remembers testifying river was rather shallow—about 200 ft. wide. (R. 2091–2092.)

HECTOR M. ZAHN

For Complainant.

(Record, Vol. 11, pp. 2074-2091)

Resides at Los Angeles, California; 51 years old; May, 1902, went into San Juan country for mining company. (R. 2074.) Brother of Otto J. Zahn.

Went from Flagstaff, Arizona, by wagon to mining property located 5 miles down from Copper Canyon on San Juan River. Had machinery freighted in from Flagstaff by team and wagon, distance of 200 miles. (R. 2075.)

Been on road out through Bluff several times.

Never seen any settlers in country west of Bluff living on ranches and farms; only people there are Indians. Buildings were already at the mine; made alterations. (R. 2076.) Lumber brought in on wagons. Stayed on this trip June, July, and August, 1902.

San Juan River was high; gradually went down latter part of July, and dried up completely for about five weeks. Started to rain first of September and when he saw it again, it was pretty high, full of floating trees and logs, at point called Butler's Wash, 15 miles down below Bluff. (R. 2077.) Went back in November; stayed until February following year. River was low; froze in January, except small streams foot and half wide; when he first went there in it was 40 or 50 ft. wide and about 2 ft. deep.

Only in country once since 1911, and that was 1915. When he went out it was by way of Bluff and Dolores, by wagon. (R. 2978.)

Saw sand waves during high water on San Juan River; these were about 4 ft. high; 1915 highest water, waves 3 or 4 ft. high. (R. 2979.)

Supplies brought in by wagon. Never saw anybody use a boat on the river. Crossed by wading river at mine. (R. 2980.)

The rise and fall of water in river kept channel constantly changing. Sediment filled up one side, diverting water over to other side. (R. 2980-2981.) Changes 100 ft. from side to side.

Fixed up old road from Tuba City to mine, 120 miles. (R. 2981.)

Had to dig down in bed of river when it went dry to get water.

Dug sump holes during that dry period, put in screen to keep them from caving. (R. 2982.)

Drove four horse team down the dry San Juan river bed about 20 miles to Colorado River to get cook, who had lost his mind. That was in 1912; returned the same way. (R. 2982-2983.)

In 1915 upon returning found buildings completely buried by silt and sediment; just roofs sticking out. (R. 2983.)

Cross examination (Vol. 11, pp. 2985-2988.)

Sand blows down in that country. It was in August, 1912, when he drove down the dry river bed. (R. 2986-88.)

Further examination:

Believes houses located 6 or 7 ft. above high water mark.

Believes entire river bed had been raised 10 or 12 ft. between 1903 and 1915. (R. 2087-2088.)

KENNETH SAWYER

For Complainant

(Record Vol. II pp. 2088-2140)

Resides at Yuma, Arizona; 43 years old; City Engineer for Yuma. (R. 2089.)

With U. S. Reclamation Service a number of years.

He went on Green River in 1918, from Green river, Utah, down to the junction of Green and Colorado; and then up the Colorado to Moab. Party was under John F. Richardson on reconnaissance for reservoir and dam sites. Investigated dam site and drilling at junction of Green and Colorado. Also the dam site below Flaming Gorge on Green River, and the dam site on the Yampa River, a tributary of Green at Juniper Canyon. (R. 2094-2096.)

Machinery and equipment for drilling operations was hauled from Greenriver, Utah, down to Wimmer's Ranch, about 25 miles below Greenriver. Two scows were specially built at direction of Mr. Richardson for carrying boiler and engine, casing and drill rods; the scows were operated on the Green about 5 ft. apart; they were approximately

6 by 24 ft., decked over. Compl. Exh. No. 263, represents the two scows. (R. 2095–2096.) The draft was 8 inches.

Compl. Exh. No. 268, is the *Marguerite,* Mr. Wimmer's boat. It had a draft of 8 inches. Also had three small row boats, two small motor boats; 14 and 16 ft. long. (R. 2097–2098.)

Down Green River the scows grounded on sand bars, so used block and tackle to get them off; shoving and reversing paddle wheel on *Marguerite* get them free; wide shallow places in river; bars choked water off and shot it over against a bank at bend rock banks, took work to keep outfit off rocks. (R. 2099.) All boats grounded frequently. Compl. Exh. No. 264, shows operation of getting off sand bar the *Betsy Ann.* Second trip was August, 1914. (R. 2100.)

Wimmer had charge of taking drilling outfit down on second trip. (R. 2100.)

Camped on right-hand bank of Green; drill scows moved to drilling place, 500 ft. below confluence of two rivers. (R. 2101.) Anchored with two iron anchors and rocks weighing four or five hundred pounds and inch cable rope. (R. 2101–2102.)

Compl. Exh. 62, Plate No. 19, shows location of drill holes. (R. 2102.)

Deepest hole drilled 125 ft. through sand and an occasional boulder; did not locate bed rock.

Had an eight-ft. rise in river, also sudden rise in Grand River; immense quantities of driftwood;

difficulty getting to drill barge in rowboat; driftwood accumulated on anchor ropes; attached lines to barge; driftwood shunted down. (R. 2104.) Lost about 90 ft. of drill rods and casing through flood. Ordered to bring outfit back.

Went up the Colorado in motor boat to Moab; overland to Greenriver in auto. Remodeled *Betsy Ann* with boiler and engine. (R. 2110–2111.) Loaded it with a little coal. Motor boats pushed one scow, and the *Marguerite* the other. Proceeded upstream. (R. 2111.)

The *Marguerite* had brought the stuff down from Greenriver to junction for the remodelling. (R. 2111.) Coal also brought down. (R. 2112.)

Going upstream on Green River; proceeded slowly; had difficulty around bends, grounded on sandbars, picked wrong channels. Took four or five days to get to Wimmer's ranch; stopped there, encountered series of gravel bars, shallow fast water; not possible to bring outfit up over bars. (R. 2112–2114.) Unloaded at Wimmer's Ranch and equipment by wagon to Greenriver.

All boats that went down to junction were brought up excepting one rowboat, which was lost at junction. (R. 2114–2115.) The two scows were pushed up the river; *Betsy Ann* came up under own power. (R. 2115.)

Survey maps, Sheets 31 to 36 of Compl. Exh. No. 10, survey made prior to drilling at junction; had use of *Betsy Ann,* two motor boats and three

rowboats below Greenriver; above, used cars and went on foot; did not use river for any surveys above Wimmer's Ranch. (R. 2116.)

Captain Yokey was in charge of operation of motor boats and navigating.

The motor boats were 14 or 16 ft. long, 4 or 5 ft. wide; draft 7 or 8 inches. (R. 2117.) Sand bars, a continual occurrence on river, considered them same as eating or sleeping, one of the regular things encountered. In getting off, jumped into shallow water, pushed the barge off, or had to wade to back end and work scow back and forth, so as to get it into water that would float it. Barge drew very little water. (R. 2117.)

Compl. Exh. No. 264, taken 50 or 60 miles below Greenriver, shows pushing scow off one of many sand bars. (R. 2118.) Paddle wheel not put on *Betsy Ann* until after the drilling operations. (R. 2118.)

Trips made with survey party, between Greenriver and junction, two with survey party; one with Diamond drilling outfit; three or four while drilling.

Trips made up Colorado, one with Mr. La Rue, and on Wimmer's boat, up Green to Wimmer's Ranch. (R. 2119.)

No fixed channel on Green River; not a fixed one as far as they could discover; except where bars threw water against rock cliffs; cliffs controlling points; water very fast and deeper; especially where river would widen out, full of low bars with

a continual shifting from day to day; never able to follow any established course in navigating; had to pick channel through the bars each time.

No marked changes with exception of flood down the Grand, with reference to stage of water; but bars shifted. (R. 2119–2120.)

Took five days to bring drilling equipment up river. (R. 2120–2121.)

Cross-examination (Vol. 11, pp. 2121–2144):

Drill outfit consisted of Sullivan type H drill engine, boiler, rods, casing, and tool equipment. (R. 2122.) Outfit assembled early part of August, 1914; started for junction under Mr. Wimmer who had contract for freighting of equipment and supplies from Floy, Utah, to the junction of Green and Colorado Rivers. Arrived at junction, August 26th. (R. 2122–2125.) Return trip arrived at Wimmer Ranch, October 29th. (R. 2122.) Good deal of coal used during operations; brought from time to time by Mr. Wimmer. (R. 2129.) Boat *Marguerite* used, believes a 1,000 of coal brought on a trip. (R. 2130.) Ten or twelve men in party. (R. 2130.)

From junction to Greenriver in motor boat *El Rita*, trip was made in three days.

Trip up Colorado to Moab, then went overland to Greenriver, returning to junction in motor boat September 5th. (R. 2131–2133.) The *Betsy Ann* was loaded with machinery and 600 or 800 pounds of coal. Weight of machinery 2,500 pounds, and three men in the boat. (R. 2137.)

Loaded scows as light as possible; cached balance of provisions and stuff in but at junction. On the trip upstream, had the ordinary hazards of the river, sand bars, and so on, commonplace events. (R. 2137-2138.)

Members of party and cook did not go up river occasionally during drilling operations. (R. 2141.) The survey trip was made from middle of July until middle of August; started below rapids in neighborhood of Wimmer's Ranch, down to junction and back up Green. Used *Betsy Ann*, not equipped with power; showed it when it would float with two motor boats; otherwise by hand. (R. 2141-2142.) Had three small rowboats. (R. 2142.) Took twenty-five days to complete survey. (R. 2142-2143.) Had sufficient supplies for period. (R. 2144.)

Further examination (vol. 11, pp. 2144-2146):

Previous to first trip to Moab and back (Colorado River) had never been on that stretch of river before. (R. 2144.) It was a battle all way up and down; walked six miles to Moab on first trip. (R. 2144-2145.)

HARRY McDONALD

For Complainant

(Record, Vol. 11, pp. 2146-2220.)

Resides at Highway, Highland, California; 77 years old; since early manhood has followed hunting, trapping, and prospecting; Lived in western

country since 1866. First entered Utah in 1868 or 1869; Second trip made in 1888.

Drove cattle from Elk Mountain, Wyoming, to Ft. Mojave, Arizona, over old pony express trail. (R. 2151.) Entered Utah on trail leading from Ft. Bridger, thru Echo Canyon; from Mountain Meadow dropped down to old Virgin River, down to St. Thomas. (R. 2152.) Down to Hardyville, Arizona. (R. 2153.)

Hardyville, Ariz., was then a small place. It is 7 miles above Ft. Mojave. At Ft. Mojave the cattle was distributed. Outfit consisted of eleven men, 682 head of cattle, 3 wagons, and horses. (R. 2156.) Followed a wagon road through state of Utah. (R. 2157.)

Hardyville is on Colorado River; had ferry for crossing river into Nevada. Saw Captain Melon's old steam boat *Gila* there. (R. 2158.)

At Callville in 1871; saw a rowboat. (R. 2160.)

Made a trip from Eldorado Canyon, through Callville up to mouth of Virgin with burros. Struck same route followed down with the cattle and went thru Utah up into Montana. (R. 2160.)

In 1887 built a boat at Cramer's wagon yard at Grand Junction; in March river was frozen over and the boat run through the ice and was pulled on top and skidded over the ice. Went down to Granite Canyon, mile from Utah-Colorado Line, after seven or eight months went into Book Mountains. (R. 2161.)

Went down to Glen Canyon with burros. From Glen Canyon went to a point midway between Greenriver and the San Rafael on horseback. Forded Green River short distance below and went on Colorado down below Cataract Canyon. (R. 2162–2163.) Crossed top of mesa north of Cataract Canyon. (R. 2163.)

Went through Hanksville to mouth of North Wash. Hanksville consisted then of a few settlers, only town in that part of country. (R. 2165.) Prospected the country and the bars. (R. 2166.) Found gold in bars but not enough to make much money. It was flour gold.

Built a small flat-bottomed skiff to cross river and did some running up and down river with lumber brought overland by way of Hanksville. (R. 2167.) Used boat to get to the bars; used on bar in center of river. (R. 2167–2168.)

In Cataract Canyon he pulled a boat up with a line to edge at foot of cataracts and came down in boat; let current take him along. (R. 2168–2169.) Made trip on a bet.

Went out from Glen Canyon by wagon. (R. 2170.)

No other boats in Glen Canyon while he was prospecting; No dredges or other machinery on river. Outfit known as Hite's was for prospecting down river about 3 miles. (R. 2170.)

First trip he made with Mr. Stanton they had six boats; lap stock boats, 14 or 15 ft. long, air-tight

compartments at stem and stern, light cedar, sharp at both ends. *Black Betsy,* one of boats, built of inch stuff bound with wagon tire iron. (R. 2171–2172.) Draft loaded, 7 or 8 inches. Sixteen men in first Stanton party. His position was to get them out of trouble, because he had already been down lower river. He was chief boatman. (R. 2172.) He has run the Mississippi River from St. Louis up and down quite a while on the old *Don Hine,* Capt. Joe Quinn.

From Greenriver down to junction with Grand River the channel is arbitrary. Get aground; have to change channel; drag boat along to find channel. (R. 2173.) Grounded four or five times a day. Great number of bars in this stretch of river. Desert sand, shifting all the time. (R. 2174.)

In Cataract Canyon; lined boats through; boats too heavy loaded; threw away blankets and coats to lighten load. Lost three boats; *Black Betsy* went to pieces. One boat run on to rocks while lining; water turned it completely over, tore bottom out. (R. 2175.) Towed rafts with food on in big board boxes. Lost the rafts and food. Line fouled while lining, current swift, back end ended up and lost boat; boats would not stand the force of water. Lining third boat; Mr. Reynolds had hold of line, went down with boat, pulled him ashore but wrecked boat. Got driftwood and skidded boats along on rocks, in place of lining; put them in at lower edge and run. (R. 2176–2177.) Boats skid-

ded along rocks across rapids and put in in stretch between rapids. (R. 2177.)

Party stopped at North Wash and obtained supplies; went on down to Hite. Repaired boat. (R. 2178.)

From Hite down the river, had trouble all the way down; bars and rocks; shelf across river, nearly 100 yards in width; have to find opening to get boat through.

Every boat run on to that; got out, pushed back into deeper water. (R. 2179–30.) (Large rock located 112 miles above Lees Ferry, crosses the river; close to what is known on map accompanying La Rue's Water Supply Paper as Bed Rock dam site). (R. 2180.)

Glen Canyon, few rapids encountered; run them going down; going up would have to get out and haul boat. Bull Frog rapid a bad place; rocks and boulders across. (R. 2181.) Mr. Brown, witness and Mr. Reynolds went down in a boat, could not get back up, slept on bar; Mr. Stanton picked them up. No shore line and water too swift, could not pull up. That is below the Escalante, and above the San Juan. (R. 2182.)

From the San Juan to Lees Ferry little trouble, except at Crossing of the Fathers where bad bars and rocks. Below Navajo Creek, boats stuck twice on sand bars.

Camped at old John D. Lee house and supplies were brought in overland from Kanab by Mr

Brown. Ten days to make the trip. (R. 2184.) At Lees Ferry only the Johnson family and Al Huntington. Mail brought in by Tom Greenalt and Fred Kaw on horseback from Kanab. Made 3 trips a week. (R. 2185.)

Trip terminated at North Canyon, on saddle of the Buckskin Mountains. (R. 2185.) Went on foot to Kanab. (R. 2186–2187.) Followed old freight route to Milford. (R. 2187.) Rode in a wagon. (R. 2188.)

On the second Stanton trip he planned the boats, drew plans, and superintended the construction at Waukegan, Illinois, boats shipped to Greenriver by rail, loaded on wagons, hauled overland to Dirty Devil by way of San Rafael, Hanksville, head of Trachyte Canyon to North Wash. (R. 2189.)

Boats were built of oak and calked; 144 ft. of air-tight compartments under running board; twelve heavy, galvanized iron cans. (R. 2190.)

Second Stanton trip was great deal like the first; sand bars and rocks. Lightened loads on boats at Bull Frog rapids; worked through rocks close to shore; stuff portaged to make boats light. (R. 2191.) Ran on to ledge across river, everybody got out; no channel where they found channel before. (2191–2192.) Had more trouble with sand bars on second trip. Supplies obtained at Lees Ferry. Went on to Gulf.

Chaffin boys were mining on river below Hite. (R. 2193–2194.)

Best Expedition in 1891 was his next trip through Glen Canyon. Boats same as used on second Stanton Expedition.

Started from Green River bridge, at Green river, Utah. Did not find channel in same place as on first Stanton expedition; channel disappeared somewhere else. (R. 2194–2195.)

Same trouble on bars frequently, down to cataracts.

Boat No. 1 lost in Cataract Canyon. Run the rapids. (R. 2196.)

In Glen Canyon had sand and bars to contend with; the channel in Colorado not as bad or changeable as on the Green, but sand is moving all the time; tried backing off with oars, but oars went down in sand so far, hard to get them out. (R. 2196.) More water in river then than at time of Second Stanton Expedition, about the same as the first Stanton. Does not believe water across ledge (in Glen Canyon) averages over six or eight inches deep. Ledge extends from one side to the other, and up and down for 75 or 100 yards. (R. 2197–2198.)

Encountered Trachyte and Bull Frog Rapids in Glen Canyon. (R. 2198.)

Supplies were obtained from Wheeler brothers near Greenriver and no other supplies obtained below Greenriver.

Terminated expedition at Lees Ferry, went out to Kanab along old mail route. (R. 2199–2200.)

Four or five months afterwards went back into

Glen Canyon mining. (R. 2200.) Helped construct the Stanton dredge on Colorado in about 1899, lumber brought from the Pacific Coast. Hauled by teams from Greenriver over trail blasted through sand rock and came down just above Bull Frog Rapids. (R. 2201–2202.) Stanton dredge was an 82 bucket, worked 60 yds. gravel an hour, could dig in 28 ft. of water. (R. 2201–2202.) Had ice plant. (R. 2202.) Equipment for dredge and ice plant brought in overland with teams and loaded on flat bottom scow and pulled up river. Used windlass, would let that wind off and let scow go down river to bar, and unload; then men on side would windlass it up. (R. 2203–2204.) Perpendicular bluff at that point and wagons could not get to river. Had rode horseback across the bar. (R. 2204.) Heaviest part of dredge was the engines. (R. 2204–2205.) Getting heavy machinery down from high land, used iron shoes under wheels; used block and tackle to get empty wagons back up; horses could not go up. (R. 2205–2206.) During construction and operation of dredge, no supplies brought in by way of river. Dredge worked river bed. Operations continued for 8 or 9 months. (R. 2208.) Medium swift water around dredge.

Saw no boats traveling on river during time he was there with dredge.

Hite was the post office, mail coming by teams from Hanksville. Hite is down the river from dredge about 4 miles; he never went down there in a boat. (R. 2210–2211.)

Last time he was in Glen Canyon was four or five years after dredge ceased operating; was placer mining; went by pack outfit by way of Escalante; stayed three months. Saw Meskin with small, light, flat-bottomed boat, draft two or three inches; prospecting and mining. Saw him pass camp several times. Saw him pulling boat upstream by means of a bridle. (R. 2213–2214.)

Cross-examination (R. vol. 12, pp. 2215–2226):

Boat built at North Wash used to prospect back and forth across river when high water. (R. 2216.) Boat towed and poled four miles above camp to Cataract Canyon to rapids he ran for sport. Ran some small rapids. (R. 2217.)

First Stanton Expedition stopped at Saddle or Fence Canyon, about 45 miles below Lees Ferry.

Dredge was located on Good Hope Bar; scow was taken down to lower bar about a mile below, and towed back up. (R. 2220.) Supplies came to lower bar; going out, went down to lower bar, used small row boats. (R. 2222–2223.)

Was on Green River prospecting, trapping, and hunting with Old Rocky. Started at old ferry and ended below Wheeler Ranch. Boat belonged to Old Rocky. (R. 2222–2223.)

From his observation of Green and Colorado, would say troubles and impediments traveling up or down on boats, about the same on Green between Greenriver and mouth of Green, as on Colorado

between Cataract Canyon and Lees Ferry. (R. 2225–26.)

Redirect-examination:

Old Rocky traded furs at the ferry. (R. 2226–2227.)

Further examination (Vol. 12, pp. 2227–2229):

Kinds of difficulties encountered were rocks and bars, and low water; lowness of water and shifting of the sand. (R. 2227.) Recalls sand waves on Green River, near mouth of San Rafael; sand moving in a bar.

Did not use maps on Stanton Expeditions or Best Expedition. (R. 2229.)

ROBERT N. ALLEN

For Complainant

(Record, Vol. 12, pp. 2233–2296)

Resides 3655 Fredonia Drive, Hollywood, Calif.; is a civil engineer. Graduate, B. S. Degree, California Tech. of Pasadena. Employed by Department of Water and Power, Los Angeles. Formerly with U. S. Geological Survey on 1921 survey of San Juan River, Mr. Hugh D. Miser, geologist with party. Mapping San Juan below elevation 3,900. (R. 2234.)

Started on San Juan River below Bluff July 18, 1921. Equipment trucked from Greenriver to point where boats launched. (R. 2235.)

River moderately high, just after customary spring floods. Went down to junction of San Juan

and Colorado, and ten miles below junction on Colorado. Progress from point to point partly by boat, usually by walking; boatmen brought boats to camp during day. (R. 2236–2237.) Two boats; boatmen, Mr. Blake and Bert Loper. Took 142 pictures. (R. 2237.) Compl. Exhs. Nos. 265–402 photographs. Compl. Exh. 403, is a schedule of the locations of the photographs with explanations.

Observed San Juan River in high and low water; minimum depth about 6 inches, slightly over that in center of stream. (R. 2239.) Where canyon narrow, width narrow, influences depth of water; open stretches at low water river 20 or 30 ft. wide, 6 inches deep. (R. 2239.) Clay Hill Crossing, stream bed from 3,000 to 4,000 ft. wide, flood times stream covers entire bed; other times, possibly not more than 20 or 30 ft. of bed. River continually fluctuating stream. (R. 2239.)

Crossings made several times a day by boat on account of quicksand; in crossing walked part way pushing boat; if stretch of water sufficient depth, got in boat for short stretch, walked rest of way. (R. 2240.)

Sand waves, waves peculiar to streams with overload of silt; phenomenon continuous; at every stage of water, principally when river is rising; continually avoiding them. (R. 2240–2241.)

Boats drew 6 to 8 inches; current of San Juan very swift downstream; boat backed downstream by rowing upstream; pulled downstream at times,

not water enough; during lower stages a daily occurrence. (R. 2241–2242.)

Rapids between Bluff and junction of San Juan with Colorado; encountered perhaps thirty.

Supplies brought by Wesley Oliver, of Mexican Hat, with pack mules, possibly twice a month; also a cache was left by boats on the Colorado River for them. (R. 2243.)

Less trouble on Colorado than on San Juan, although had difficulty with rapids below junction of San Juan. From a point ten miles below junction took one boat with boatman Loper to Lees Ferry; also Heber Christensen.

Between junction of San Juan and Colorado to Lees Ferry difficulties seemed mild in comparison with San Juan. (R. 2244–2245.) Sand bars, ran aground four or five times. No rapids in lower stretch of river.

Boats made for Southern California Edison Company, shipped to Greenriver, and by truck to river below Bluff. (R. 2246.)

Cross-examination (R. Vol. 12, pp. 2246–2253):

None of photographs in exhibits are of San Juan during low-water stage. Eleven days of time between July 18 and October 14 spent on Colorado River. At Clay Hill Crossing, when a member of the party wanted to walk across river, he sunk almost to his waist in quicksand. (R. 2249–2250.) Trip down river to Lees Ferry took day and a half,

camped opposite Navajo Creek during night; distance 68 miles and boat rowed downstream. (R. 2253.)

Redirect examination (R. Vol. 12, pp. 2253-2254):

Pictures not taken of low water because not interested in that at that time. At Piute Farms river too high to venture on with boats. Because of constant fluctuating in amount of water, sand bars changed at all times. (R. 2253-2254.)

Further examination (R. Vol. 12, p. 2254):

Sand bars varied in location from hour to hour, stream would vary five or six feet in a day. (R. 2254.)

Recall (R. Vol. 12, pp. 2295-2296):

Compl. Exh. 373: Mr. Lopier and Mr. Miser starting from Piute Canyon to go to Spencer's Bar for supplies; pulling boat upstream in comparatively low water. (R. 2295-2296.)

DAVID E. RUST

For Complainant

(Record, Vol. 12, pp. 2255-2294)

He resides at Provo, Utah; age 55 years; cattleman, school teacher, editor, miner. (R. 2255.) Became first acquainted with Green River when crossing with band of horses in 1891; half the horses were crossed on ferry boat, rest of them swimming. Greenriver a small town then. (R. 2256.) Crossed river where present bridge is. (R. 2257.)

In 1897 fitted up a boat at Hanksville; brother took boat to mouth of Last Chance Creek from Hite; horses taken overland. Boat had been hauled in overland; supplies came in wagon and taken down in boat. Operated placer claims about three months. Winter of 1897 and 1898 Stanton boats passed the camp. (R. 2257–2258.) Party of prospectors came to camp in January, 1898, in a small boat, and he took them out with saddle horse and pack animal to Escalante. (R. 2258–2259.)

Nathan Galloway visited camp on his way up river in a small boat; going up by rowing and towing. (R. 2260.)

Saw two or three small row boats on the river. Upstream from Last Chance to Hall's Crossing, 60 miles, in boat, rowing and towing; hard work. Went out to Hanksville and north overland. (R. 2261–2262.)

June, 1898, from Hite to Hanksville with pack train and down to Good Hope Bar on horseback; worked for Good Hope Mining Co., sluicing gravel bars. (R. 2262.) Average of 20 men working there; took supplies from Hanksville to Hite, and then down river in a 20-ft. row boat. Took boats upstream by rowing and towing. (R. 2263.) Met Mr. Stanton and party doing assessment work on river in vicinity of Good Hope and Hite. Summer of 1898. (R. 2263–2264.)

Mr. Stanton was using boats up and down river in assessment work and they were operated by

usual method. Several small row boats at Hite. Draw about a foot of water loaded.

River was at medium height during that July and August. (R. 2265–2266.) Great deal of difference in channel and sand bars when river at high, low, or medium stages. Channel will change within a week. (R. 2266.) Medium water, river easy. Low stage of water preferred in boating; did not attempt to navigate in high water usually during June. (R. 2266–2267.) After mining over, went out on horseback by Hanksville. (R. 2268.) Did some boating in Grand Canyon up and down Colorado for about 15 miles at mouth of Bright Angel Creek in 1907.

Since twelve years ago he has average of one trip a year through Glen Canyon, conducting travelers in scenic lands of Utah. (R. 2268.) Boats were taken through Crescent Creek or North Wash to the river and launched there, and run down to Lees Ferry; took tourists by automobile or wagon, and horseback to mouth of Crescent Creek. (R. 2268–2269.)

The boats used on tourist trips are small and of canvas, called King Canvas, a folding boat, made of 22-ounce, double-filled duck, waterproof; steel ribbing, crossways and longitudinally; 14 and 16 ft. type (R. 2269); 5 ft. wide, draft of 6 inches when loaded; row boats; carry two persons each, luggage, and supplies. (R. 2270.) During tourist trips in past twelve years, opportunity to observe the

conditions of river. Selected small boat because they are easily and quickly managed to avoid sand bars, shoals, whirlpools; the wind waves drives boat ashore. As to sand waves, he would cross and recross to keep out of them. (R. 2271–2272.) Discovered less water shipped if boat put lengthwise of trough of sand waves and floated down sideways. (R. 2272.)

Between Crescent Creek and North Wash there are some small rapids, Trachyte, Tickaboo, Bull Frog, and Rainbow. Boats released from sand bar by working them across or backing them up.

From Warm Creek to Lees Ferry water pretty swift; good many sand waves in lower stretch.

Last trip was made September 1, 1928; September 7, 1929, went to make trip but river was at flood stage and did not go on; returned back overland. (R. 2274.) April and September good months for trips.

On one trip, one boat capsized in sand waves; hit waves and turned over backwards; just before reaching Lees Ferry; came down bottom side up. (R. 2275–2276.)

Parties are met at Lees Ferry by automobiles and go overland sometimes to Kanab and sometimes to Flagstaff. (R. 2276.)

On Green River in 1929; came from Torrey with pack outfit and went by boat from mouth of Barrier Canyon on the Green to Fort Bottom, about 15 miles; Tidwell used boat from Greenriver to Bar-

rier Canyon, towards lower end of Labyrinth Canyon.

Trail along river within sight of boat nearly all the way. (R. 2278-2279.) Fort Bottom is a flat and there is an Aztec fort, and a cliff ruin; then came back up river with pack outfit; left boat there.

Did not meet any other people using boats. (R. 2279.) Torrey is 150 miles from the Green River. It is Canyon country; sheep range country.

Saw few men drilling for oil and half dozen cattle men. (R. 2280.)

Cross-examination (R. Vol. 12, pp. 2280-2283):

The parties were conducted down river for compensation. (R. 2281.) Boat loss was due to foolhardy act on part of those handling boat; happened in April, 1926. (R. 2282.) Ladies have made the trip. (R. 2283.)

Redirect examination (R. Vol. 12, pp. 2284-2294):

Five days actual running time trip from Crescent Creek down to Lees Ferry, with two or four days for side trips.

Reef or strata of rock runs cross stream 15 miles below Hall's Crossing; has had trouble there; it is called reef rapid or shock rapid; narrow channel 40 to 50 ft. wide to right of island going down; channel not less than foot deep. (R. 2285.)

Recross-examination (R. Vol. 12, pp. 2285–2286):

Water deeper other places in little narrow channel to right of island. (R. 2286.)

Redirect-examination (R. Vol. 12, pp. 2286–2291):

Ledge does not extend across the channel; channel half a mile long; channel cuts right under wall of canyon on right side. (R. 2287.) Light boats drawing 6 inches, able to go over rapid without striking bottom. Ledge rapid, rough; waves too rough. (R. 2290–2291.)

Recross-examination (R. Vol. 12, pp. 2291–2292):

Never been on Colorado from Moab down to confluence with Green. (R. 2292.)

Redirect-examination (R. Vol. 12, pp. 2292–2294):

Saw no other boats on the pleasure trips past twelve years other than government boats, except at Lees Ferry. Buck Lowry's gasoline launch at Lees Ferry, 25 ft. long; used for hauling lumber across river. Saw several row boats and ferry boat at Lees Ferry; saw one or two small row boats cross river; observed boats government had to make 1923 run. Carpenter's boat at Tickaboo, small row boat. All the boats he ever saw on the river.

Recross-examination (R. Vol. 12, pp. 2294):

Never saw government boats up river above Lees Ferry. (R. 2294.)

DEAN DAILY

For Complainant

(Record, Vol. 12, pp. 2297–2305)

He resides at 5134 Raley St., Hollywood, Calif., 25 years of age; with Tiffany Stock Company; graduate of University of Washington, 1927.

Experience boating on Columbia, Snake, Colorado and Green Rivers. With Pathe-Bray Expedition on Green and Colorado in 1927; same expedition Mr. Owen Clark and Mr. Val Woodbury were on.

Left Greenriver, in November, 1927, with five boats. (R. 2298.)

Between Greenriver and mouth of San Rafael, continually grounding on sand bars; especially mud flats around San Rafael; water very low. (R. 2299.)

From San Rafael down to junction of Colorado and Green; water shallow; sand bars; good many riffles; did not see any other people in boats; did not see any people in cabins.

Cataract Canyon, had great deal of difficulty; water shallow, boats grounded continually. (R. 2300.)

First part below junction very shallow water; further between rapid and riffle; rocks protuding all along surface of stream; necessary to pick a course. (R. 2301.)

Some of rapids Cataract Canyon made portages; rocks large and numerous; holes knocked in boats. (R. 2302–03.)

Hite, abandoned mining town; sand bars numerous; water shallow.

Did not see any boats or meet any people living along river. (R. 2203–2204.)

Expedition ten or eleven days behind schedule account difficulty navigating the stream. (R. 2304.)

Cross-examination (R. Vol. 12 p. 2305):

Film in litigation; film tied up. He did not wear life preserver. (R. 2305.)

BERT LOPER

For Complainant

(Record, Vol. 12, pp. 2306–2337; Vol. 13, pp. 2340–2448)

He resides 73 South 2nd East, Salt Lake City, Utah; 60 years of age; Practical miner; mined in Colorado, Utah, Nevada, Arizona, and New Mexico. (R. 2306.) Familiar with Utah around Green, Colorado, and San Juan Rivers; first entered country in fall of 1893; placer mined on upper San Juan in 1893; bal[illegible]ce of time on San Juan from Bluff to junction [illegible] Colorado. (R. 2307.) Freighted in March, 1894, to Honaker trail; stuff let down over ledge of cliffs with ropes. (R. 2308.) In 1893–1894 placer mined around Hyde Trading post. (R. 2308, 2309.) Remained there 1894 and until May, 1895. Outfit brought in supplies by wagon.

Made trip on San Juan River from Honaker trail to mouth of Copper Canyon, in 16-ft. rowboat. (R. 2311–2312.) Trip made in August; had little water; had to drag boat along. (R. 2313.) At Indian Farms in 1895 river was 300 ft. wide; no channel to float boat. Boated down river probably 60 miles. (R. 2313.) At rapids, one time took boat out of river; worked around boulders at mouth of Grand Gulch. (R. 2314.)

In February, 1895, above Mendenhall cabin, encountered sand waves; ice gorge stopped flow of river; ice gorge broke, flood formed sand waves. (R. 2314–2315.)

Up river, boat was dragged because not sufficient water to row in.

Indian Farms is 27 miles down from Chinle Creek; 57 miles up from Junction with Colorado; Piutes used to be there. (R. 2316–2317.)

Went to Bluff and then to Moab by horseback; saw two rowboats, 16 ft. long; they left Bluff with provisions while he was there. (R. 2318.) He made a trip in July or August; river was low; lots of difficulty. (R. 2318.)

Lined over rapid at Soda Basin; nosed over Gypsum Creek rapid. In nosing a boat you get out and get hold of nose, no lines used. (R. 2319.) Lining a boat would walk along shore, boat would be out in river. (R. 2319.) 1894 or 1895, at foot of Honaker trail, saw river rise eight feet. Box canyon there and talus slopes, canyon steep. (R. 2320.)

Stayed at Moab until October, 1895; ferry boat there; saw 16-ft. rowboat at Moab. (R. 2321.) While at Moab did not see any boats bringing or taking merchandise on river.

Back on the Colorado in 1907; was with U. S. Geological Survey under K. W. Trimble in 1921. Joined party at Greenriver; helped carry survey from Moab to Bluff, and on down to Lees Ferry. (R. 2322.) Party had three open boats with flat bottoms, flared sides, 16 in. deep, 4 ft. beam.

Between 1895 and 1921, at Indian Farms, the farms had completely gone; river in 1895 was 300 or 400 ft. wide; in 1921, 3,300 ft. wide. (R. 2223–24.) River in 1921, estimated 6 ft. deep over that width. (R. 2324.) While camped big flood came down; have floods usually in July. (R. 2325–26.) Rapid at Grand Gulch of big boulders in 1895, and in 1921 it had disappeared. (R. 2326.)

On the 1921 trip, portaged rapid just above Slick Horn Canyon on San Juan. At Grand Gulch, big sandstone cliffs; wall rocks, bends in river shut off walking on one side, makes another bend, shuts off on other side; river wider and shallower; boats catch on sand and tip sideways; river digs in and digs talus slopes away from wall rock. (R. 2327–2329.) Long loop at the Narrows; no place to walk; big sand waves; boat filled half full of water. Big rains had blocked the trail used by supply pack train; arranged to take boat up river and meet packer at Spencer Canyon; Mr. Miser and he

(Loper) dragged boat up river seventeen miles to get supplies; this was in month of September. Compl. Exh. 373 picture showing them going up the river; water very low. (R. 2330–2332.) Reefs across; took two days to go up seventeen miles. (R. 2332.) Going down stream, took whole day; pulled boat good part of way; ended boat over reef; crossing bars and crossing channel cause river to cross; crossing bars formed by side canyons sweeping floods in river, forms a bar that takes down the river and crosses over to the other side; in time the river cuts through. (R. 2335.) Bars invariably are on the inside bend of river; velocity of water carries it to the outside of bend; channel on outside of short bend, when river becomes straight or starts to make a reverse bend, between the two bends there is a crossing; flattens out and spreads over river. (R. 2336.) In 1921, saw no boats on San Juan while there; no ferryboat at Mexican Hat.

Took two men down to Lees Ferry, from the mouth of the San Juan, distance 70 miles. From Lees Ferry back, used motor boat, equipped with stern wheel, Sterling engine, Ford differential; boat was 22 ft. long, 6 ft. wide; square nose scow boat. Going down stream to Lees Ferry principal difficulty was sand bars, water was low; sand above mouth of Navajo Creek. (R. 2341–2342.) Upstream from Lees Ferry, trip consumed four days. Encountered channel crossings just above Last Chance Creek; waded trying to find channel; one

place had boat running, three men on a side, and worked boat over a sand bar. Two rock reefs, had to do the same thing. (R. 2343.) Water flowing about 8,000 second-feet. (R. 2343.) Last Chance Creek, next big loop above Crossing of the Fathers. Crossing of the Fathers a ford where Kane Creek comes in from the west; walls break down so that river can be reached. (R. 2345–2346.) Photo 243, Compl. Exh. 11–D, Crossing of the Fathers. (R. 2345–46.) Compl. Exh. 404, is foot of Honaker Trail showing bend in river. (R. 2346.) Where sand waves pile up; waves curl backwards, crest of wave falls upstream. (R. 2346.)

In Glen Canyon, placer mining in 1907; started from Greenriver, Utah, September 19th and went to Hite. Charles Russell and Ed Monette members of party. Had 3 steel boats, launch hulls, 16 ft. long, 18 in. deep, 48 in. beam; no motors. Decked over, keel boats. Had low water leaving Greenriver, and immediately below hit a riffle. (R. 2347–2348.) Below mouth of San Rafael encountered sand. (R. 2348.) In Labyrinth and Stillwater Canyons had trouble at channel crossings; ran aground. Channel crossing is a place where channel leaves one side of river bed, crosses to opposite side; on a loop the channel should be on outside, if river starts to make a reverse curve channel changes from outside of first loop across river to outside of next loop, and in this crossing the channel spreads out; trouble navigating these

rivers because no channel, it spreads out over the shifting sand bars. Big rocks shoot the channel clear across to other side of river. Not possible to observe deepest water; many times no channel through which to run a rowboat. (R. 2349.) Had difficulties with channel crossings and sand bars daily. (R. 2350.)

In Cataract Canyon there are numerous rocks in the rapids; portaged one rapid, boats, loads and everything; 16 cataract is a bad one. (R. 2350, 2351.) Did not run a rapid without life preservers. Did not wear life preservers on Green River. (R. 2351.)

From end of Cataract Canyon went on down past Dirty Devil to Hite and stayed several days. Narrow Canyon has deep quiet water.

Cataract Canyon is narrow in part, not over 100 ft. wide. (R. 2352.)

Same conditions from Dirty Devil down to Hite, same old conditions. Mouth of North Wash is a crossing bar, channel crossing, only one little channel through there. (R. 2353.) Went down to old Stanton dredge, 42 miles below North Wash and back to Hite; provisions and supplies came by freight team.

Pulled boat back up river from Stanton Dredge to Hite, in November, 1907; towed the boat 90% of the time. (R. 2355.)

Went from Hite to Lees Ferry January, 1908. Five days making trip; grounded several times, serious rocks in Shock Rapid.

There is a rock ledge in river at Mouth of Lake Canyon. (R. 2356.)

From Lees Ferry upstream to Hite; had a line about 120 ft. long on boat and walked up; there are places where he waded to get around point of sand and always was wet. At rapids coiled rope in boat and nosed the boat up over rapid. (R. 2357–58.)

Placer mined at Red Canyon all summer. (R. 2358–59.) Saw no other placer miners. In summer of 1908 some people mined at where he had mined on down trip, but they left by wagon from old Stanton dredge. Supplies obtained by wagon from Hanksville or Greenriver. From Red Canyon he would drag boat up river and get the supplies. (R. 2360.)

Hite, in 1907, had a post office of log cabins. Hite is at head of bar about 2 miles long and one-fourth mile wide. Trachyte Creek comes down to river there. Cultivated and irrigated land on both sides of Trachyte Creek; probably 20 acres. Compl. Exh. 11–D, photograph 199, is Hite as he saw it in 1907; shows Trachyte Creek and rapids. (R. 2360–2361.)

Red Canyon is a long bottom; placer ground 195 ft. above river; ranch on bottom land. Picture 200 of Compl. Exh. No. 11–D represents ranch. (R. 2362.) Not irrigable from river; lies 22 to 25 ft. above river; irrigated from springs and a little stream.

Between 1907 and 1914 studied the Colorado river; lived there alone. Made numerous trips on

river from Greenriver, Utah, to Lees Ferry; trips to Stanton dredge, to Olympia bar, and to California Bar. Observed different stages of the river. Channel changes at all stages except at high water. (R. 2363–2364–2365.) Sandbars are left by high water on inside bend of river; high water cleans the river; summer floods undo the work of the high water, fills the channel full of sand again.

During seven years' observation of Colorado River he did not arrive at a knowledge that would enable him to follow a channel at a crossing without getting stuck on a sand bar because there is no channel there. (R. 2365–2366.)

Each year high water deposits sand on inside curve; rains wash banks away, sand is distributed somewhere further down. (R. 2366–2367.)

Have to hunt for channel on a crossing.

Every change in river volume means a rearrangement of channel bars and sand bars.

The different stages of water make it a different river. (R. 2367–2368.) Sand waves occur below the San Juan. (R. 2369–2370.)

In December, 1911, made a trip from Hite to Lees Ferry, with Bert Seaboldt and George Meiss. Had a boat, 18 ft., 52-inch beam, flared sides and flared bottom, draft 6 in. Purpose, placer mining. Not a motor boat. (R. 2370–71–72.) Encountered the usual sand bars; run on rock in Trachyte Rapid; run on rock in rapid below Shock rapid; went through middle channel, hit a gravel reef. (R. 2371.)

The boat, the *Chas. H. Spencer,* was being constructed; has not seen it since he saw its nose sticking out of sand at Lees Ferry in 1921.

Trip made back to ranch in February; river gorged with ice, went up the river, same old way, dragged boat up with a rope. Arrived Hite 18th of February, 1912.

Left Red Canyon in 1914, walking to Hite, horseback to Hanksville, and walked to Greenriver.

Made trip from Greenriver, down Colorado. (R. 2373–2374.) Had fifteen to eighteen thousand second feet more water in 1914 than in 1907. Rapids that were mild in 1907; they were "ragers" in 1914; rapids that were bad in 1907 had entirely disappeared in 1914. Cataract No. 16 was a fury. (R. 2374.)

Had two Muller steel boats, pleasure boats; depth 12 inches; not water-tight. (R. 2375.) Had keels. (R. 2375–2376.) The 3 steel boats he had in 1907, two were lost below Lees Ferry; third, swamped and went down the river.

From Green River to mouth of San Rafael, had no trouble because of increase in flow of water. Encountered bar or two in Labyrinth Canyon. Water was at flood stage all of the time he was on Green River; drift during floods make boating in rapids bad. (R. 2376.)

In Cataract Canyon in 1907, Rapids Nos. 1, 2, 3, 4 were mild, No. 5 bad.

In 1914, Rapids Nos. 1, 2, 3, 4 were fierce rapids No. 5 gone entirely. Rapid No. 4, had waves 20 ft.

high, he estimates. (R. 2377.) A rapids draws down in a long smooth stretch of water in form of a "V," biggest at end of "V," waves at end; cut across "V" lines and get into short waves four or five ft. high; 16 ft. long boat rides larger waves better than small ones. Purpose of trip, was for taking motion pictures; 5,000 ft. of film was lost in Cataract Canyon. (R. 2378.) Russell's boat got water logged; in a long rapid Russell's boat went out from under him. (R. 2379–80.) Spent two days trying to locate boat. His [Loper] boat was tied and washed full of sand. Built a raft of drift to cross river. Can only walk on one side, river crosses, have to walk on other side. Can walk all way through Cataract Canyon, with exception of part at mouth of Dark Canyon. (R. 2380–81.) Raft was lost. Walked up to Spanish Bottoms; started to climb out. (R. 2382.)

Cataract Canyon comes up high, then there is a mesa, then there is a big ledge, trail is on the ledge. (R. 2383.) Climbed out and walked down to Hite. West side of Colorado, land used for grazing purposes, and did not see any houses or people during trip. Went down to Red Canyon, back to Hite, and out to Greenriver. (R. 2384.)

On Green River, September, 1914, with John F. Richardson of Reclamation Service, drilling holes at junction of Green and Colorado. Went by wagon from Greenriver to Wimmer's ranch; from Wimmer's Ranch to junction in power boat Marguerite. Marguerite was 25 ft. long, 7 ft.

beam, stern wheel, 12 H. P. marine engine. (R. 2385.)

In Labyrinth and Stillwater Canyons, at the break, barge *Betsy Ann* was backed up and lashed to the *Marguerite* and taken down river; total length of combined boats approximately 50 ft. Remained until outfit came out and helped take boats and equipment back up Green River to Wimmer's Ranch. Outfit consisted of two barges six ft. wide, 20 ft. long, lashed together, separated and one put ahead of *Marguerite,* and the other hauled up by two small motor boats, 16 ft. long. Boiler and drilling equipment on *Betsy Ann* and a paddle wheel rigged on; boiler was used for power. (R. 2386–2387–2388.)

Went upstream to Wimmer's Ranch, on Green River, distance of 95 miles, required about four 8-hour days. On sand bars frequently; water low, sand bars not as much trouble upstream as they were down. (R. 2389.) Boats unloaded. *Marguerite* continued up river with eight or ten men aboard. Boat grounded below the Auger, and took a little time getting over Auger. Gravel island below Greenriver bridge; all hands out and pushed boat over; water shallow. (R. 2390.)

Went by team from Greenriver to Hanksville; met Frank Lawler and went with him to Hite. (R. 2391.) Trail along east side of Colorado River, crossed river by fording to get to Hanksville. (R. 2392.)

Worked on Good Hope and Tickaboo Bars, Colorado River, for Mr. Seaboldt and Mr. Evans, prospecting, until May, 1915. (R. 2393.)

Run a light boat, 18 ft. long, run up and down river 18 miles between Hite and Good Hope Bars on Colorado River. (R. 2394–2395.)

On Colorado River, in 1916, with Ellsworth Kolb, commenced 9 miles above Glenwood Springs, boated on down through Westwater Canyon to Cisco Pump House in Utah. (R. 2395–2396.) (R. Vol. 13, 2397.) Testimony admitted to be the same substantially as Kolb's. (R. 2397.)

On Green River in 1922, with Geological Survey K. W. Trimble in charge. Started at Green River, Wyoming, terminated at Gray Canyon. (R. 2398.) Testimony substantially the same as the other witnesses on this stretch. (R. 2398–2399.)

On Green and Colorado Rivers, September, 1929, with Archie Ryan and Colonel Dent, trip from mouth of North Wash to Lees Ferry. Overland to North Wash by way of Hanksville; boat was 16 ft. long, semikeel round bottom, square end, Evinrude motor; taken from Salt Lake. Boat was taken from Greenriver to mouth of North Wash overland by way of Hanksville. (R. 2399–2401.)

On Colorado River between mouth of North Wash and Red Canyon, touched bottom with oars in lots of places; Trachyte rapid is bad water. Did not use motor in bad water. In the break in Trachyte Rapid although had lots of water it is

shallow right in the break, there is a gravel reef that runs across the river, after getting over it run into rough water. (R. 2401.) At Olympia Bar, got out, nosed the boat around to get over. (R. 2401.) Stage of water 12 or 14 thousand second ft. Just touched rocks in Smith Fork Rapid; dragged motor along on gravel above Lake Canyon. (R. 2402.) At Shock Rapid, took same channel taken before, but it proved to be the wrong one. Severe rapid with four big rocks; zig-zagged through by inches.

At mouth of San Juan, had big sand waves, rode through parallel. (R. 2403–2404.) Had sand wave condition down to mouth of Rock Creek. (R. 2404.)

From San Juan River down, Colorado is a different stream; San Juan carries considerably more sand than Colorado. (R. 2404.) Comparison of Colorado between 1907–1908 and 1929: Glen Canyon, 1908, could walk along one side or other of river; to-day numerous places where river extends from wall rock to wall rock; bars and bottoms have disappeared; he estimates 5,000 acres of land disappeared out of Glen Canyon. (R. 2405–2406.)

Glen Canyon, between 1908 and 1914, all traffic done on river was just 16 and 18 ft. rowboats; row where they could and rope where they had to in coming up river.

Boats seen, Bennett, had a boat or two; Lon Turner had a steel boat, 24 ft. long. (R. 2406–

2407.) They were used by those persons themselves, not for carrying supplies up and down river for other people. (R. 2406–2407.)

They met Julius Stone and party; saw no other parties. (R. 2407.)

Changes in Green River since 1907: Channel run along right bank above railroad bridge in 1907; small channel on east side; island there now, not much stream on right bank in high water channel filled up and full of cottonwoods and things; to-day river comes down on east side. (R. 2408.)

Compl. Exh. No. 405, Vol. 13, 2408–2409, is the Hole-in-the-Rock, where Mormons crossed the Colorado in 1879 and 1890, showing old dug way on left bank. (R. 2409.)

Compl. Exhs. No. 406–407, show the Hole-in-the-Rock on right-hand side of river. Wagons were brought down through narrow chasm. (R. 2410.)

Cross-examination (R. vol. 13, pp. 2410–2445):

San Juan, first trip made in July or August, low water. (R. 2410.) San Juan, August, 1894, May, 1895, placer miners at mouth of Slick Horn Canyon. Came into San Juan on burros. (R. 2411–2412.)

Trip from Slick Horn to Copper Canyon about 30 miles; came back up river from Copper Canyon by pulling boat upstream. (R. 2413–2414–2415.)

San Juan, trip with Mr. Miser, rowed boat at one big bend for little ways coming down stream; boat

contained 450 pounds of supplies. (R. 2416–2417.) Towed upstream exclusively.

1894, Beldon and Worthington, members of party of five, with two boats of supplies at point between Honaker Trail and John's Canyon. (R. 2418.) Mr. Beldon helped build boats.

Colorado River; saw Mr. Wimmer at point halfway between mouth of San Juan and Aztec Creek; came to camp in a row boat. (R. 2419.) Saw Mr. Wimmer in a rowboat with outboard motor halfway between Last Chance Creek and Crossing of the Fathers. (R. 2420.)

Came upstream from Lees Ferry with Mr. Marrs, a mechanic of the California Edison Co. (R. 2420–2421.) Boat of Emory Kolk at mouth of San Juan and Mr. Wimmer's boat only boats he saw there. Wimmer's boat 16 ft. rowboat.

Upstream from Lees Ferry walked part way; pushed motor boat 30 or 40 ft. over a sand bar; 50 ft. each side of two rapids; power boat went up river 68 miles. (R. 2425.)

After he became established at Red Canyon took boat up to Hite for supplies three or four times a year. (R. 2430–2431.)

Supplies used by Mr. Seaboldt while testing bars in 1915, came by wagon from Hanksville to Hite; supplies from Hite came by pack horse on west side of river. (R. 2439.) Used big boat of Lon Turner's; made a big scow and floated it down, drawing possibly 3 inches of water. (R. 2439–2440.)

He made trips for Seabolt, and was paid so much a day for hauling supplies on river.

Frank Bennett was on Olympia Bar in 1910, 1911, and 1912, went down and back on horseback; sometimes carried supplies for himself in boat. (R. 2440.) Turner used boat for himself. Witness ran his boat between Good Hope and Hite, bringing down light stuff, for so much a day compensation. (R. 2443.)

Green River, between Greenriver and confluence with Colorado, is wider than Colorado in Glen Canyon. (R. 2444, 2445.)

Colorado between foot of Cataracts and Utah-Arizona line, not deeper than Green between Greenriver and confluence with Colorado, stream runs faster, but is not deeper. (R. 2445.)

Redirect examination (R. Vol. 13, pp. 2445–2448):

Mrs. Seaboldt went down river in boat with him and was at camp for about two months; she rode from Hite to Good Hope Bar; went out on horseback. There is a trail from Red Canyon to Hite; leave river 5 or 6 miles just before you get to Hite and come back down White Canyon. (R. 2447–2448.)

WILLIAM L. MARRS

For Complainant

(Record vol. 13, pp. 2450–2486)

He resides at Inglewood, California. Followed electrical and mechanical lines. Chief Machinist's mate as instructor in submarine service, U. S. Navy.

At present is a school teacher. He was on Colorado River, for Edison Company, in 1921, as boatman, and made a second trip in 1922.

Boat, first trip, was purchased at San Pedro, shipped to Flagstaff, and overland to Lees Ferry. Boat 26 ft. long, 5 ft. wide, tunnel stern, with propeller wheel in back end of boat. (R. 2451.) Exh. No. 408, photograph of boat. Draft 12 in. loaded. Boat launched at Lees Ferry during first of August. (R. 2452.) Crew of two besides himself, some passengers; and some supplies for establishment of camp and food for passengers. (R. 2452–2453.)

Upstream from Lees Ferry the propeller kicked all the water out and boat would settle in sand; get off drift back. Had capstan and 500 ft. of line, put out line and would wind boat off sand bars, and four or five men drag over the bar. (R. 2453.) Lines taken ashore sometimes four or five times a day to get off some bar. (R. 2453.) Made nine miles in two days, became disgusted, turned back and returned to Lees Ferry.

Survey party and Mr. Fowler used boat hauling supplies to survey camps, party moved a few miles a day. Made several trips. Moved camp, between moves come back for supplies; there over a period of five months. (R. 2454–2455.) Did not go above the Utah line more than six or eight times on these trips.

Previous experience, three years in Idaho boating on lake, and on other rivers in Idaho. Had

operated stern wheel and propeller boats on a river. (R. 2456.)

The best stage for operation of boat on Colorado River was when a flood ran by; flood would take out bars; best going was next few days after a flood.

August is low water season; flood from thunderstorm would come down, and would run by, take a day to run, while going by would clean all sand out; for four or five days channel would be fairly clean of troublesome bars. River would rise a foot per hour sometimes during flood. (R. 2456–2457.)

After flood, would have to pick way behind, get line out and go over, or get out and push over; make a mile or two per hour, going as fast as they could; would only make a mile or two miles per hour going up river.

Going up river hardest physical work, but easier to keep boat free from bars and rocks. Power boat has to keep headed straight into current; if boat gets sideways, it turns or heads for shore; lost a minute you drift back more than you can make in fifteen minutes. (R. 2458.)

Channel never the same from one week to another; would find dozens of bars in places where he had gone over before; sudden or low rise would wash out channels and bars; different conditions. (R. 2459.) Where river quiet, a bar will form. Water swift at right-angle bends, on left-hand side no bar, water cuts bar out, on other bank bar would run out. Water so swift can't go up in

bend with a boat, but have to come out where boat channel is; as water goes down, slows down, bar forms towards bend, crowds you further in the bend where swift water. In river regulations, channel defined, as the path for the boat to travel; do not always pick deepest water, too swift in deep parts; if not so swift, a bar is there. Sand settles where water is quiet. (R. 2459–2461.)

Channel going down different than channel going up. (R. 2462.) Put markers to indicate where bad bar; could tell where bars would be from river bends; every mile or two would encounter bar, forming sort of a dam in river. (R. 2462–2463.)

Propeller broken after few trips because of sand and rocks. (R. 2463–2464.) Put on paddle wheel; wheel kept boat from settling on bars. (R. 2464.) Crew had to get overboard almost every day. (R. 2465.)

Boat operated first year five months; second year off and on about four months. From August until December; from November, through most of January. (R. 2466.) Second year Edison Company drilling at dam site, five miles above Lees Ferry, boat hauled supplies and equipment up about five miles.

From Lees Ferry to Warm Creek, least trouble in boating; 8 or 10 miles above canyon, walls disappear and river wider and shallower. (R. 2466.)

From Bridge Canyon down to 10 miles above Lees Ferry, river is about the same. (R. 2466–67.)

Boat called the "Navajo"; Compl. Exh. No. 409 is boat after paddle wheel put on. (R. 2467.)

Cross examination (R. Vol. 13, pp. 2468–2483):

Where had to get out to pull over a bar, left a mark on rocks, or by piling up two or three stones; not necessary to mark for return trip; did not do any marking on upper river on the one trip where he went above Warm Creek. (R. 2468–2469.) Marked from Lees Ferry up to Warm Creek. (R. 2469.) Did not mark on trip upstream with Mr. Loper because farther than he would have to go in his work. (R. 2469–2470.) Changing conditions referred to down below Utah-Arizona line. (R. 2470.) Very few markings were of value because channel changed before he got back. (R. 2471–2473.)

Engine on boat a Sterling 24 H. P., and best speed made against current about 2 miles an hour. (R. 2474.)

Bridge Canyon and Aztec Canyon the same and 10 or 12 miles below the mouth of the San Juan. (R. 2476.)

Made better progress with paddle wheel, before that towed boat most of the time. (R. 2476.)

Second year, larger wheel and different engine put on; larger wheel more successful; managed to get up river without so much towing; never went

more than 10 miles up from Lees Ferry. (R. 2479.) Never made an up trip to Warm Creek in less than a day and a half. (R. 2480.)

Redirect Examination (R. vol. 13, pp. 2483–2484):

Supplies were deposited on the left-hand side, or west side, of Warm Creek. Warm Creek comes into the river from the west and runs nearly east and west. (R. 2484.)

Further Examination (R. vol. 13, pp. 2484–2486):

The paddles of an eight-foot paddle wheel, do not necessarily have a deeper draft in the water than the paddles for a five-foot wheel. They did not on this boat.

The five-foot wheel had sixteen paddles on it; they were so close together the paddle doesn't get time to fill with water—the paddle hits more at an angle to the water; with the larger diameter we put on twelve paddles; the paddles enter the water more perpendicular to the surface of the water, and get better hold; as the paddle passed the water had time to rush to fill the place before the next paddle hit the water. Got more efficiency with power they had. (R. 2484.)

On this tunnel drive, the effect of that was to take all the water out from under the rear end of the boat and have it drop clear down; the boat was built with a tunnel inside, the idea being you could go over the bars without the propeller digging into

the sand, which was a good idea in salt water, where the boat was built. But over there, when you dug the water out there was nothing to get in the tunnel; your wheel runs in water. It was a good idea if it worked.

The rear end wouldn't drop any more than the depth of the water, if we were trying to get over a shallow sandbar, because the water wasn't swift there; the boat would come along and kick all the water out; you couldn't go, because there was no water for the wheel to take hold in. The water couldn't get into the tunnel, being built up under the boat. A propeller doesn't work if there is no water. (R. 2485–2486.)

FRANKLIN THOMAS

For Complainant

(Record Vol. 23, pp. 2486–2490)

He resides at Pasadena, California; civil engineer connected with California Institute of Technology.

Made trip on Colorado River from Hall's Crossing to Lees Ferry in 1922; representing city of Pasadena, interested in securing water and power from the river.

Traveled from Richfield to Noton, Utah, about 100 miles by automobile; then by four-horse wagon to Hall's Crossing; three-day wagon trip. (R. 2486–2487.)

At Hall's Crossing, met by Tom Wimmer; Wimmer had four round bottom, square end, boats about

16 ft. long. Left Hall's Crossing September 8, 1922. Boats operated in pairs, lashed together tandem fashion, outboard Evinrude motor on rear end of each tandem.

First rapid encountered first half day leaving Hall's Crossing; a number were encountered on way down. (R. 2487–2488.)

Boats shipped water; boats grounded in one or two instances on rock ledges just above rapids. Ran all rapids. Grounded on sand bars several times a day; pushed off with oars when possible, when not, got out and shoved boats off. Lewis R. Freeman, member of expedition as boatman. (R. 2488–2489.) Comp. Exh. No. 81, opposite page 175 (book—"Down the Colorado" by Lewis R. Freeman), picture of other tandem boat; taken shortly after passing the Crossing of the Fathers. (R. 2489–90.) One boat was grounded on bar at that place. Required eight days to make the trip, reached Lees Ferry September 16; stuck on bar just after crossing State boundary line.

Further Examination (R. vol. 13, pp. 2492–2494):

The trip was made for the purpose of investigating possible dam sites on the stretch of the river covered. Rough topography was taken at each site that had possibilities or merit.

The first site looked at was the so-called Bed Rock dam site, which is just below Bed Rock

Rapids. The next was at the San Juan, another at Oak Creek, and another at Rock Creek. The personnel of the party was largely composed of engineers from the United States Geological Survey. (R. 2492.)

The surveys made were the initial surveys of the particular sites; the expedition of 1921 had not reached that portion of the river, as he understands it.

Colonel Birdseye, Mr. LaRue, Mr. Stabler, and Mr. Arthur P. Davis, were the government engineers in the party. There were four other boatmen besides Mr. Freeman, including Tom Wimmer, Andy Wimmer, a man named Rawson and another named Jones, making five boatmen in all. Besides these there were Dr. Widtsoe, representing the Governor of Utah, Mr. Young of Richfield, Mr. Stetson, secretary of the Colorado River Commission, and Charles P. Koehler, an engineer of the Union Pacific Railroad. (R. 2493–2495.)

There were sixteen men in the party, including boatmen, so that there were four men to each boat. That is the average per boat but not the way they rode. In the tandem in which he rode there was Mr. Young, Mr. Stetson, Andy Wimmer, Rawson, and Jones, making six passengers. This boat also carried most of the supplies, consisting of boxes of canned goods and a good deal of bedding, weighing somewhere between five hundred and a thousand

pounds. The draft of the boat was nine or ten inches. (R. 2493–2494.)

Cross-examination (R., Vol. 13, pp. 2495–2499):

In speaking of proceeding at easy stages, he means it was necessary to make frequent stops to examine the dam sites and the party was not trying to make time.

He does not recall both boats being stuck at the same time, since they did not always travel together, the motor on the boat in which he was riding being unruly and it was three-quarters to half an hour later getting started in the morning than the other boat. The boats traveled in sight of each other about half of the time, the other half of the time possibly within half a mile of each other, but he observed no instances where both parties were stuck at the same time. (R. 2495.)

He did not see any so-called sand waves.

He would say that the boats were stuck so that it was necessary for the boatmen to get out of the boat and shove it into deeper water twice in half a day each day, the occurrence depending more upon distance than upon time. (R. 2496.) If they traveled continuously for half a day, would say man stepped into water twice would be a fairly correct estimate of it. (R. 2496.)

Tom Wimmer was the skipper of the front boat and Andy Wimmer was skipper of the boat in which he [Thomas] was riding.

Both of the boats in tandem naturally got stuck at the same time but he does not know whether or not the tandem condition added to the difficulty. It would cause additional weight to be handled in getting clear; that is all. There would be two boats to get into deep water instead of one but there were twice as many boatmen to handle them. (R. 2497.)

He was on that river eight days. It became a very common thing, for boatman to step into the river to help get a boat off a bar. (R. 2497–2498.) He refreshed his recollection from his diary before taking the witness stand.

"A. I would say the boatmen were in the water twenty times.

"Q. Twenty times?

"A. Yes.

"Q. You give that answer without attempting to recall specific instances?"

He recalls specifically the first time the boat was stuck because that made an impression on him and of course he recalls the incident when the other boat was stuck and his boat went by. There were other instances which he does not recall to mind but they are mentioned in his diary. The two mentioned are outstanding in his recollection. (R. 2498–2499.)

Redirect-examination (R. Vol. 13, pp. 2499):

Arthur P. Davis, who was a member of the party, is now in Russia. (R. 2499.)

BENJAMIN D. HARSHBERGER

For Complainant

(Record Vol. 13, pp. 2500–2521)

He resides at Valentine, Arizona; operates store and service station. Lived at Needles, California, and conducted mining operations on San Juan River first in December, 1892.

Entered San Juan country by team from Winslow, Arizona, reaching San Juan River about 40 miles below Bluff; followed trail to San Juan near Nokai Canyon; wagon left on top of bluff, supplies packed down; ten people in party; possibly 25 miners in canyon when he got there. (R. 2500–2502.) Stayed about two months; teams were sent back to Winslow for supplies; other parties on river supplied by pack horses from Bluff. (R. 2502–2503.)

During the time he was there, did not see any miners receive supplies by boats on river; did not see any boats on river; saw some row boats when he returned in 1902.

From 1902 to 1921 in San Juan country most of the time was interested in oil operations and drilled near Mexican Hat about a mile from the river bed. (R. 2504.)

Tools and casings used in oil drillings, were brought in by team from Colorado points to Bluff and down to drilling sites in lighter loads; the rate for freighting from Bluff to Mexican Hat was 3 or 4 cts. per pound. (R. 2507–2508.) Freight to

Dolores and Mancos, Colorado, by railroad; freight rates from there to Mexican Hat about 4 cts. per pound; hay in Bluff cost about $15 and at Mexican Hat when landed worth $80 a ton.

Roads were poor from Bluff to Mexican Hat, hard traveling. (R. 2506–2507.) Continued operations in San Juan country until about 1925 and saw river frequently; saw a few small boats on river belonging to prospectors from Farmington, N. M.

Never knew of placer miners or oil prospectors bringing machinery in with boats; a few prospectors came down river in boats, but never saw any of them go back up river. (R. 2057–2508.)

Merchants in Bluff did not use river for sending out or receiving merchandise. Had ferry boat used in trading with Indians; Indians only people that could man ferry boat, stripped off clothing and zig-zagged boat across. (R. 2508.)

Observed sand waves at many points from Bluff on down; usually occurred during high water and after storms. (R. 2508.)

Prospecting in 1892 crossed river number of times with burros; crossed in December in knee boots without getting knees wet. (R. 2508–2509.)

He had some experience on Colorado River while mining property in White Canyon near Hite in 1907, 1908. Went to Hite overland from Bluff with pack animals; crossed on cable Ferry; went out overland by way of Hanksville to Greenriver. (R. 2509.)

From Bluff to Hite he followed old road Mormon people had in there; outfit of two or three men. Crossed in row boat; few times brought animals over on a bar above post office. (R. 2510.)

Prospecting in 1906, 1907, and 1908; supplies hauled from Hanksville; some machinery from Greenriver.

He investigated the possibilities of bringing mining machinery down the Green and Colorado Rivers to Hite, investigation being to the rapids above Hite and also from Greenriver down to Wimmer's ranch. He did not go through Cataract Canyon. (R. 2514.) Concluded that it was safer practice to haul them overland. (R. 2515–2516.)

After coming to this conclusion he loaded machinery on wagons at Greenriver [Utah] and hauled it to Hite by way of Hanksville and North Wash.

After arriving at Hite he built a ferry and ferried the machinery across the river, and moved it up to White Canyon with teams, after fixing up an old road a distance of about thirty miles from the Colorado River.

The ferryboat constructed was about twenty-eight feet long, twelve feet wide, and had a draft of about fifteen inches. The lumber for constructing the ferryboat was hauled overland from Greenriver. (R. 2516–2517.)

Cross-examination (R. Vol. 13, pp. 2518–2521):

When he first went down the San Juan River in 1892 placer miners were scattered over the river for

a distance of about thirty miles and in later years they operated largely in the winter and placered from Chinle Creek down to within about twenty miles of the mouth of the river. These operations continued until about ten years ago, covering a period of from about 1892 to 1919.

It is impossible to make the placer mines pay with the present methods of operation.

The few prospectors who had boats would go from Bluff down to their placer claims on the river and take with them their supplies. He saw probably three outfits go in with boats; most of them went in with burros and pack animals. As he remembers, two of the outfits who used boats went in in 1904 and the other about 1906, he being at Bluff at that time and saw them go through.

The principal mining on the San Juan River was done between 1892 and 1902, and he was there only during the two months of that period. (R. 2518-2521.)

RICHARD ELMER CALDWELL

For Complainant

(Record, vol. 13, pp. [illegible])

He resides at Los Angeles, California. He is a civil engineer by profession, has had experience in hydraulic work, municipal engineering, irrigation, and drainage. He was also a member of the Colorado River Commission, representing Utah, prior

to 1922. He was State Engineer of Utah during the term 1920 to 1924.

He has been on the Colorado River at three points, entering it on the first occasion at Hall's Crossing, September 8th, 1922, when he represented the state of Utah on the Colorado River Commission and went to the river to make general observation, thinking it might be of use in his work and of general value to the state. As he remembers, there were sixteen people in the party, including boatmen. (R. 2522-2523.) It was the same party to which Mr. Thomas testified.

He heard the testimony of Mr. Thomas, his description of the boats used, and noted that he said the boats were twenty feet long with a five-foot beam. In his judgment the boats would draw a foot of water loaded. (R. 2524.) They were equipped with outboard motors and lined up in tandem with the motor boat at the stern, two in tandem.

He didn't make any particular effort to memorize incidents but recalls Whirlpool Rapids, and some rapids at the Bed Rock dam site. As he recalls, the party made a stop at Bed Rock Rapids to make a casual examination of the site from standing on the bank.

He did not take any soundings and doesn't recall that anyone else did. (R. 2525.) Were occasionally caught on sand bars with our boats." (R. 2525.)

This is more an impression than a definite recollection, his impression being that they expected to strike several sand bars every day and thought nothing of it if they did.

Mr. Thomas, he thinks, was riding in one of the other boats, they being separated in two parties. They aimed to travel together as nearly as possible, camping at the same place every night and leaving the same camp sites. They were not successful in traveling together, getting out of sight of each other occasionally. He thinks Mr. Koehler, Mr. Freeman, and Mr. Tom Wimmer, who ran the motor, were in the boat in which he was riding. (R. 2526.)

Compl. Exh. No. 410 was identified by him as a picture of the party with him. (R. 2526-2527.) He is fellow in boat. Mr. Herman Stabler was also a member of that party. (R. 2527.) Between Hall's Crossing and Lees Ferry were never free from the sand-bar nuisance, or of expecting a sand bar; it continued throughout the course. (R. 2527.)

He again went on to the river at Diamond Creek at the Geran dam site, stayed there a few hours, then went back, got on the river at the mouth of the Virgin River or Boulder Canyon, and went down to Needles [California]. Both of the last places named are in Arizona. (R. 2527.)

Other than the trip he has never been on the Colorado River in the State of Utah. He has been on the Green River but has never navigated it nor has

he ever operated a boat on the Grand River. (R. 2528.)

Cross-Examination (R. Vol. 13, pp. 2528–2529):

There must have been deeper water, or we would never have gotten off the sand bars. Were always able to float after we pushed it a certain distance, or an uncertain distance.

His getting stuck may have been occasioned by not getting into the deeper portion of a given stretch; could not say as to that positively. (R. 2528–2529.)

FRANK BARNES

For Complainant

(Record Vol. 13, pp. 2529–2536)

He resides at 1669 East Florence Avenue, Los Angeles, California; has been peace officer for several years; prior, served in U. S. Navy; operated boats for one year at Galveston, Texas, while in navy, captain of a yacht; some experience on Colorado River; some on Mississippi River.

First in San Juan country in 1908 at Bluff, and remained until 1918. (R. 2529–2530.) Has been down river below Bluff to Spencer's Camp about 30 miles up from junction with the Colorado. He saw row boats cross river a few times and saw two boats going down, but nothing going up.

Trip in flat bottom row boat from four miles above Bluff to mouth of Comb Wash, latter part of

July or first of August. (R. 2531.) Had to pull boat over some sand bars a time or two. Water was at medium stage. (R. 2531–2532.)

He was on Colorado River in 1910 at Lees Ferry; went down from Bluff on horseback. (R. 2532.) Crossed river at Comb Wash and went through the Navajo Indian Reservation, to Tuba City and Moenkopi, and down the regular road to Lees Ferry; several in party. (R. 2532–2533.) Purpose of trip was to handle machinery and boats for Chicago Exploration Company. Supt. was Charles H. Spencer. (R. 2533.)

Boat at Lees Ferry, gasoline launch, 18-ft. keel bottom, 4½-ft. beam, 18-in. draft. Also a ferryboat at Lees Ferry; some row boats at Johnson ranch; and he helped build a row boat.

Upstream from Lees ferry made short trips to try boat out, distance of three or four miles; went up after flood waters. One trip to Dandy Crossing from Lees Ferry, over 100 miles up river. Albert Jones, Arthur Waller, and a man named McDermott on trip. 13 days making trip; made in July or August. (R. 2533–2535.)

Lined boat good many times; pulled with lines, and was wrecked about three times; row boat turned over on two different occasions; launch got crossways of a rapid and was carried down into a rock and turned over.

Encountered difficulty with sand bars; forced launch off by hand. Started with 500 pounds of

provisions, lost most of them when row boat capsized about 12 miles above Warm Creek. (R. 2535–36.)

Downstream to Lees Ferry, had a rise in water and no difficulty going down. Purpose of upstream trip to Dandy Crossing for locating claims and to see about navigation.

Larger boat was brought in; 27 ft. long, 5½ ft. beam, draft 2½ ft.; equipped with 4-cylinder gasoline engine, 40 H. P.; also a scow to use in connection with it.

Went upstream with scow and big boat to the mouth of Warm Creek for coal about the last of August, 1910. (R. 2538.) Crew of four men besides himself; got stuck ten times between Lees Ferry and Warm Creek; loaded about 300 pounds of coal at Warm Creek and came back. (R. 2539.)

Downstream from Warm Creek, ran on sandbars about twice; best water was encountered below Warm Creek.

Only made short trips with large launch after that, about two or 2½ miles up for prospecting purposes. Launch to haul coal, used as a tugboat. (R. 2540.) Large launch brought in from Flagstaff by team.

If did not hit current just right going upstream, would turn around; several times turned clear around and head down stream again; only one way to land; go down river until found place large enough to turn around and head back up; pro-

peller boat will not steer going astern. (R. 2540-2541.)

Installed a dredge at Lees Ferry; dredge was hauled in overland from Flagstaff including lumber for barge and machinery for dredge. (R. 2542.)

Compl. Ex. No. 411, camp few miles above mouth of San Juan River showing rowboat and powerboat used on trip to Dandy Crossing. (R. 2543.)

Compl. Exh. 414, rapids near mouth of Aztec Canyon; shows McDermott and self going thru rapids with powerboat.

Compl. Exh. 412, picture of rowboat going ashore before they got the water out of it. (R. 2544.)

Hand-spiked boat off bar and let it swing clear. (R. 2544.)

Cross-examination (R., Vol. 13, pp. 2545-2547):

One of the two rowboats he saw going down the San Juan River was one he used himself and the other he saw about a week before with two men in it. He thinks that perhaps they were miners from the outfit they had in their boat, but he didn't know who they were. The boat was headed down at a point about four miles up the river from Bluff. He couldn't say whether or not the two men in the boat stopped at Bluff. (R. 2545.)

It was the small eighteen-foot launch that he took up to Dandy Crossing in July or August, 1912. He did not see a stern-wheel boat on the river at that

point and he was not at Lees Ferry when there was such a boat anywhere above there.

He has had no acquaintance with the boat known as the Charles H. Spencer, and he didn't get to Dandy Crossing with the large launch. (R. 2545-2546.)

While he was there he did not go up to the coal property and there had been only about three hundred pounds of coal hauled from Warm Creek down to Lees Ferry. (R. 2547.)

Redirect Examination (R., Vol. 13, pp. 2547.):

When he said that the water was better below Warm Creek than above he meant that it was easier to navigate because the river was wider and there was not so much swift water, also the water was deeper. (R. 2547.)

Recross examination (R., Vol. 13, pp. 2548):

The river was both wider and deeper. He only went above Warm Creek once. (R. 2548.)

Further examination (R. vol. 13, pp. 2548-2550):

In 1908 went from Bluff to Spencer's Camp went overland; from Bluff to Comb Wash, as far as he ever boated on the San Juan River. (R. 2548-49.)

Has been up and down Colorado River to Dandy Crossing, encountered sand waves; character of Colorado, when river straightens up, it widens out and is a little bit slower; that is, where there are

sand waves. River commences to rise, stirs, or digs the sand out and the sand rolls in a big, heavy stream. Confined to center of river usually; mostly below mouth of San Juan; navigated by going to the side. (R. 2549.)

LEWIS RANSOME FREEMAN

For Complainant

(Record vol. 14, pp. 2553-2560)

He resides at the Explorers' Club, New York City, of which he is a member. He was educated at the Pasadena High School and Stanford University, graduating in the latter institution in 1899. (R. 2553.)

He is an author, explorer, and World traveler.

He has made considerable examinations in connection with rivers. The list of rivers that he has traveled being a very long one.

To state as briefly as he can merely by name a number of the African and Asiatic and European rivers he has been on, and perhaps mention at a little greater length those of North America, and his reasons for having studied them: in the course of perhaps 15 or 20 years travel abroad he has been on the Yangtse, through the Ichang gorge of the Yangtse; on the Salmeen and the Irrawadi in Burma; the Ganges, the upper Indus; in Kashmir; had been particularly interested in the use of native craft; took every opportunity to attempt to use them, sometimes with not entirely satisfactory results to himself; these little skin boats on the Indus,

on the Tigris and Euphrates, the native craft there, in Africa called Kalek and Gufa. Boated by steamer or by launch pretty well to Gondokoro about two thousand miles from the mouth of the Nile. Has boated for lesser lengths the Zambesi in South Africa. Of South America has some knowledge, beginning at the northern coast of the continent, of the Orinoco; in British Guiana of the Demerara and the Essequebo. The Amazon in Brazil and the Negri in the same country. Further south, of the the Parana and Uriguay [*sic* Uruguay] and the Ygnazu on which the very remarkable waterfall of the same name occurs. Several of the shorter rivers draining to the west coast in Chili, of which he remembers especially the Rio Bueno, and one or two rivers of which he does not recall the names. This is pretty well the South American list. The North American is somewhat fuller, and my navigation or attempted navigation of them is more comprehensive.

His original interest in the rivers was largely due to the fact they have figured so much in our earlier history of which he has long made a study, and in later years have been writing of considerably. He found in the explorations of the early explorers the river was the inevitable route which they followed. It occurred to him in doing a bit of history if one could cruise these routes in very much the same type of craft of nearly the same size and character, under the same conditions as the

early explorers, such as Lewis and Clark or Mackenzie, one would get an interpretive understanding which you could get in no other way. For that reason during the last fifteen years, especially during the last ten years he has covered almost all of the principal rivers of the United States and Canada. (R. 2554–2555.) Previously had had some experience with the Yukon.

He has touched on quite intimately the great trade routes of the United States in his book that he completed two or three years ago called Waterways of Western Wanderings. After voyaging the Ohio, then the Mississippi from the source to the mouth, then the Yellowstone from the Mississippi to New Orleans, he endeavored to record the way in which the early pioneers crossed the Alleghanies to the forks of the Ohio where the Alleghany and Monongahela come together; Washington's early surveying there; the first voyages of the South; the way the Ohio route was used, first by the explorers then as a battleground of the Indians in the French and Indian wars and the Revolution, and finally as a commercial route for the settlements, then as the settlements pushed beyond the Missouri how they still used the Ohio and went down the Mississippi, then used the Missouri upstream following the route of Lewis and Clark, and finally down the Columbia on the other side. The inevitable route has been the river and he was traveling it for its light on earlier history. (R. 2556.)

He has touched the Canadian waterways originally in my first voyage. He went to the source of the Columbia, heading near Lake Windemere in British Columbia, followed that north between the Rockies and Selkirks on the route of Thompson and the old Hudson Bay explorers. Turning south and crossing the American line, he followed the river down to tidewater at Portland. That was the first Canadian river he touched and voyaged.

Several years later, in 1924, took a small boat with an out-board motor, sixteen-foot boat, decked over carefully against storms, ran that with the out-board motor from Milwaukee to New York. That was the route of Goliet and LaSalle and Marquette.

He voyaged up Lake Michigan, through the Straits of Mackinac, thence to Georgian Bay. Then there is a series of canals and lakes and rivers called the Trent canal, in which about forty locks occur in a distance of twenty-five miles. This takes one from Georgian Bay, cutting out Lake Huron and Erie, leaving one at the head of the St. Lawrence. Then he voyaged down the St. Lawrence to the mouth of the Richelieu, which drains Lake Champlain, running the numerous rapids on that river, most of which are passed now by canal. He continued up the Richelieu to Lake Camplain, and thence by the New York barge canal to the Hudson, and on to New York. (R. 2557.) That was my second experience in Canada.

Summer before last he was working on what was to be a book covering the earlier explorations and the present day status of the development of North Canada—The Nearing North.

He went to Edmonton, and from there to the Peace river, up that river by the regular Hudson Bay steamer; then endeavored to pass through Peace river canyons which Mackenzie had endeavored to boat in 1793 with a birch bark canoe. There had been no record of the point he reached in the canyon.

He took a birch bark canoe with an out-board motor, and after losing the boat and the motor and getting very wet and scratched up, he finally located the point which Mackenzie had to leave Rocky Mountain canyon and portage. That was his experience on the Peace river.

Returning to Edmonton by rail went on to a waterways boat there; I took a steamer down the Athabasca and the Slave and the Mackenzie to tidewater, following Mackenzie's route. Then returned by steamer and by rail to Edmonton.

Then voyaged down the Saskatchewan river, again on the route of the old explorers, in a folding canvas boat with an outboard motor. This carried me to the Pas, from whence he portaged to the Nelson river, which he boated down to Hudson Bay. (R. 2558.)

In nearly every instance he operated the boats, where it was not steamer travel, and very frequently alone, but where necessary with the aid of

one or more boatmen, or, as in one of my Colorado river trips, under the direction of another boatman. (R. 2559.)

As a result of his explorations and research he has written several books. (R. 2560.) Down the Columbia, published about 1921; Down the Yellowstone, about 1922; the third A History of the Colorado River, Yesterday, Today and Tomorrow, for which he had been collecting historical material for a long time. That was as nearly as he could make it, a history of the river explorations and a study of the possibilities of future development. Following that, he wrote another Colorado river book called Down the Grand Canyon, which included an account of the voyage he had made through the Grand Canyon with a geological Survey party in 1923, and a trip he made up and down Glen canyon the year previous, a voyage he had made through the delta of the river, and a voyage through the Alamo river, which takes the drainage of the Imperial Valley to Salton Sea, two hundred feet below sea level.

His book "On the Roof of the Rockies," was first published as an article for the National Geographic, under the title of "Mother of Rivers." The Columbia ice fields to the roof of the Rockies is the only place in the world in which three major rivers head leading to three major oceans, the Columbia to the Pacific, the Athabasca to the Arctic, the Saskatchewan, Lake Winnepeg, Hudson Bay, and the Atlantic. (R. 2559-2560.) That dealt only

slightly with historical matters of the West, where he mentioned, possibly, the survey of the Canadian Pacific. (R. 2560.) "The Nearing North" was a book of my study of the Canadian rivers in relation to earlier history and present-day development. The book, "Waterways of Western Wanderings," was the one mentioned in connection with the Ohio and the Missouri and the Mississippi, the way they had figured in the earlier explorations and the later commercial development. (R. 2560.) The book, "By Waterways to Gotham," was a book on the Great Lakes voyaged by the old route of Champlain. The book, "Down the Yellowstone," that was partly on a trip through Yellowstone Park on skis, and a boating trip from Livingston, Montana, some distance, and possibly a trip to the mouth of the Yellowstone river. On the historical side this was a study of Captain Clark's route in the Lewis & Clark expedition of 1805 and 1806. (R. 2561.)

As preliminary to the writing and the publishing of the book entitled "The Colorado River, Yesterday, To-day and To-morrow," by Dodd, Mead & Company, 1923, which is Compl. Exh. 81 in this case; on the historical read everything he could in any way lay hands on concerning the early explorations of the river from the time of Alarcon, the Spanish navigator, down to the year of publication. (R. 2564.) He read the best available source of every character, and was greatly aided in the search by the existence in the Southwest

Museum in Los Angeles of a library of Arizona, which had been collected over a long period of years, and covering not only material on Arizona, but the southwest and the west generally, a great many books that would have been available to him only after a very long search through scattered libraries. These were all concentrated there. This even ran to earlier magazine articles he had never heard of, concerning Powell's voyage in the 70's; he read all of them. He entered into correspondence with every living man that he could learn of who had voyaged on the river, in checking the Powell voyage or the Stanton.

He regrets very much he missed several of the voyagers who have now been brought out to this trial, but Mr. Dellenbaugh, of the Powell voyage, wrote him a dozen letters or more with a great deal of information.

Of special use was Julius Stone, of Columbus, Ohio, and some of the Stanton records in New York which he had access to through the courtesy of his daughter, Anna Stanton Burchard. Generally, every available source which he believed to be authentic was consulted in the restricted time he had to work in. (R. 2565–2566.) The accounts read of Alarcon were mostly from Mr. Dellenbaugh's books. Does not know where the Alarcon records are.

In the first chapter he refers to the Castenada, which is the only known account of Coronado's

explorations; that was with relation to the visit of Cordenas, believed to be the first white man who had seen the Grand Canyon. That narrative has been in existance a long time, and has been published and republished. Does not know where the original is. (R. 2566.) It was after that preparation that he wrote the book concerning the history and exploration.

The part concerning the later chapters he gained from his contact with various parties of the Geological Survey, and other engineers with whom he had voyaged on the river. (R. 2566.)

In his investigation of the Colorado river he found that the Indians in and about the Colorado river never used the river for transportation, except on the lower river below the Grand Canyon, where they always did boat, and do to this day.

On the upper river there was no evidence they had ever boated the way the Indians have on the other rivers where the explorers used them.

In Powell's investigation in preparation for his voyage, that point came up clearly in his endeavor to find boatmen among the Indians. No one could tell him anything about the river. He was completely in the dark. That was one of the things that always made his voyage an epic of exploration. He dove into the dark in entering the canyons of the Colorado.

The only known white man on the Lewis and Clark voyage was a half-breed French-Canadian.

His wife was an Indian by the name of Sacajawea, of the tribe living between the headwaters of the Jefferson fork of the Missouri and the Snake, where the drainage of the Missouri meets the drainage of the Columbia. The principal use of this woman was as an interpreter, though her personal knowledge of the region near her home on the continental divide was of considerable value to the expedition. (R. 2571.)

In August and September, 1922, he personally made a trip on the Colorado River from Lees Ferry, Arizona, to Halls Crossing within the state of Utah. He was first asked to join the party, and he requested instead that he be allowed to become a boatman on the trip going both up and down the river. That arrangement was made. For that reason he was a boatman on the party that went up, and later on the return trip. (R. 2572.)

Four boats of the skiff type were used; does not recall measuring them; always spoke of them as eighteen-foot boats; that is within a few inches of their exact dimensions; very broad skiff, square stern; originally very stoutly built, with some oak framing. Remembers there was an oak stem or bow, and had been used one or two seasons. They were built and owned by the Southern California Edison Company, borrowed by the survey at this time. (R. 2572–2573.) The draft would depend entirely upon the amount of the load. With the cargo that they carried up—they were very heavily

loaded at all times, both coming up and coming down—they would have been drawing from six to eight inches. That is a difficult thing to say without actual measurement. (R. 2573.)

To aid in the upstream navigation used three Evinrude outboard motors, one new Elto motor which he had sent direct to him from the factory. That gave us one for each of those skiffs at the start. (R. 2573.)

The Elto Motor was equipped at the factory with a hinge. The Evinrudes, which originally had a perfectly stiff engine, were clamped on to a hinged frame on the back of the boat, so they had all the advantage of my Elto; because of the hinge the motor struck a very much lighter blow than would otherwise be the case. There were six men in the party going upstream. (R. 2574.) There were four boats. He was alone; a boatman by the name of Bill Jones was alone, also; in Tom Wimmer's boat there was one assistant; Wimmer's son, Andy, also had one man with him. (R. 2574.)

This trip was not an engineering trip to survey the river; it had no commercial purpose; Mr. LaRue was very much interested in the river.

He asked a number of individuals whom he desired to gain a fuller knowledge of the river, including Mr. Arthur Powell Davis, and a number of others whose names are mentioned in his book, he asked them to make the trip down the river.

As a writer, he had been making some study of the Colorado river development. He was asked

originally for the purpose of giving him a fair opportunity to do a magazine article upon it. It had a connection with these dam projects. There were several dam sites on the river. Surveys were made of each of them, not a thorough survey that would enable the dam to be built, but surveys which would indicate to a certain extent how favorable this or that site was. That was more or less incidental. (R. 2574–2575.)

Commencing with the first day's progress upstream, his most distinct recollection of the first day was getting the enormous accumulation of luggage into the boats and finding they could carry it—we were supplying the party coming down—of finding the boats could be handled with these large loads. They made a very impressive departure, the only occasion on the trip in which the four boats got away together and continued running together. They ran all the way around the first bend without a breakdown. That greatly impressed the whole population of Lees Ferry—all four of them—who were down to see them off. Does not believe any navigation as impressive as their getaway occurred on the whole voyage. Nothing occurred until they passed the first bend, as far as his recollection goes. After that, things were occurring pretty regularly for the next day or two days.

Just around the bend somebody's motor, perhaps was Bill Jones's, hit something and went out of order. His ceased a little bit after. Mr. Wimmer went on and got out of sight; he was reading

the water better and handled his boat with more skill. Finding Bill Jones laid up in an eddy, he (witness) tried to help him out by giving him a tow to start his motor. His tow line became tangled in witness' motor, and both boats were nearly swamped before getting out of the whirlpool, Finally they got clear and started. Not until halt at noon did he look at the walls and notice the beauty of it; he was so busy up to that time he has no recollection of it until the down trip. (R. 2575, 2576.)

The first day they made six or seven miles; it was less than ten. (R. 2577.) In that stretch he encountered no sandbars which gave serious trouble, except through the faults of their own navigation nobody touched them. There was very fair water there. Rocks and swirls, being carried against banks, did bother him and one or two of the others. (R. 2577.).

The second day, camp was at the mouth of Waweep creek, a point made noticeable by the existence of a striking monument called Sentinal Rock. Roughly the two days averaged a little less than ten miles a day; thought they were doing very well considering the difficulties. (R. 2577.) Recalls very little difficulty from the sand bars on the second day. (R. 2577.)

Remembers a particularly spectacular storm or cloudburst that occurred in camp at Waweep, one that broke somewhere back from the river, and were wondering whether would be menaced by the

torrential discharge which might come down the creek; were wondering whether that would be brought down to us. Saw the clouds go over, and heard the crash of the thunder; knew the rain was falling, and wondered whether the flood would come down upon our camp, and were greatly relieved the water did not come down Waweep. If that came in at all, it was below; no effect at all on them.

The following day there was one of the most spectacular storms he ever remembers, either at sea or on land, one of the very rare instances in which he thinks human beings have been allowed to get that near to a heavy cloudburst and yet entirely without danger. Near the heart of a cloudburst, as he understands it, there is a fall of solid water; not a rain, in the sense that they know it. (R. 2578.) Saw these heavy clouds gathering; had been on the river but a little way; pulled in, moored the boats as efficiently as we could against the bank, and retired, not in a deeply inset cave, but under a good, solid overhang of the sandstone cliff, which made them perfectly safe from any direct fall overhead. Saw this dark cloud come across as solid and tangible a thing—almost as solid and tangible as an enormous Zepplin passing through the air; saw the belly of this cloud begin to sag with the weight of the water; watched the black mass of nimbus until it went over a sharp pointed butte. The action seemed to have the effect almost of

tearing or breaking up the cloud as it would if a dirigible had run onto a church steeple.

The effect it had on the Colorado river, on the river itself there was evidence of only a very slight rise. When the contents of the cloud tumbled down the precipitous side of this butte saw actual white water, somewhat as if it was a real cataract. The roar was as heavy and raucous as the descent of an avalanche of rock. Some of that water came to the river above, but without materially affecting its flow; but the storm left a tremendous wake of twisting air-currents which bothered us in the navigation later in the afternoon.

Remembers being in trouble with Bill Jones' boat in getting up there; we were thrown together considerably. From that point on up the river, their speed improved a little from that day; he remembers that from the notation in my diary; at the Crossing of the Fathers, which was forty miles, we had averaged ten miles a day, which means that had made a better speed on the last two days on the first two. Shortly after the passing of the storm were in trouble again; remembers particularly Bill Jones trying to find what he thought was an open channel up to a series of sand bars. Getting up into it, finding there was no outlet, he endeavored to lighten his boat by lifting out his load so the craft could be dragged down through; then he piled the stuff up on the sand, only to find his boat floating back. He remained with his cargo while his boat

went adrift; recovered that for him, and he had to retrace his course somewhat to get a better channel; were like a herd of cows, in a way, going through, one would go ahead and then another. Mr. Wimmer, being rather more familiar with the river, and a little better hand with the outboards, would usually get away from us, then he would come back to help someone along. (R. 2580.) Remembers at this trip he got ahead, and endeavored to make a landing on the bank, and slipped; boat went out under him; he chased it in the water; he landed on a bar; the boat went by; ran down to try to get ahead, and caught it; tried to keep his companions from learning as much of my mishandling of the thing as he could, but he always thought they suspected it. (R. 2581.)

He experienced more difficulty with the motor than he ever had in his life with that type of motor; the cause of it was the silt and extremely sharp sand.

The silt affects your motor by scouring; was warned of that in advance. With the three Evinrude motors, Mr. Wimmer's experience told him a plunger pump was entirely useless, didn't even attempt to erect pumps.

The previous year he had used on the Missouri a motor of this same type that he was now using. He found in spite of silt he could make a pump last two or three days without scouring out. He didn't realize the Colorado had a sharper silt than the

Missouri. He figured by getting a spare set of pumps—he had eight or ten of them—that the thing would carry through. Mr. Wimmer showed him the practical way out of the difficulty. (R. 2581.)

Towards noon a little steam began to rise from his cylinders; the motor stalled down; allowed it to cool, and started it again; in a few minutes the motor stopped; repetition of over-heating all afternoon, and finally went out completely; had to line his boat up a rapid to reach camp. That night examined it. That plunger pump of either brass or bronze was completely scoured through at one point, with the rest of the walls so thin could crush it between fingers. He took Mr. Wimmer's advice, and did as he had done, rigged a five-gallon oil can on the stern with a rubber pipe which he had provided for such an emergency to the cylinders; then as navigated dipped up water into the oil can; this ran down around the cylinders by gravity and cooled that. Dipping of the water thus provided something more for him to do; one needed as many hands as an octopus to handle the engine and an occasional oar for sounding.

Rapid is an extremely elastic term. They find things called rapids on the Mississippi one would smile at if called a rapid out there. (R. 2582.) In the first forty or fifty miles there is nothing except by a stretch of the imagination that any one would call a rapid. Heavy, strong, swirling current, but not the broken sort of thing one would call a rapid.

(R. 2583.) The nearest thing that by any interpretation would be called a rapid was not very many miles below the mouth of the canyon which drains from Rainbow bridge; it is called Aztec Canyon. The condition is more serious then from the fact it was—more difficult from the fact that that night there occurred one of the heaviest and most widely spread cloud-bursts they encountered. A tremendous storm broke, precipitation heavy enough to raise the river several feet. (R. 2583.)

Previous to reaching that rapid, his engine had gone out completely, and that one of the other engines had also failed; my engine simply scoured out the gears; left it on the bank. One of the other engines had gone completely, leaving only two that we were working, the one that Tom Wimmer had, and the one that his son was handling. In order to get a working arrangement, the two boats were lashed together. His boat was lashed ahead to Mr. Tom Wimmer's boat, that of Jones ahead of the others; the disabled Evinrude was taken along to furnish spare paris for the two remaining ones; operated at a thirty-six foot unit, with Mr. Wimmer steering his boat, with Bill Jones helping with the oars, and with me in the Evinrude boat rowing; the other unit was operated by Andy Wimmer. That had happened previously to where we came to this rougher water which might be described as a rapid. (R. 2583–2584.)

Sand bars were less trouble on the upstream trip than on the down, when the river was low; were

more troubled by the current, too much current against the banks; occasionally get out and lift the boat off of sand bars if we were stuck. (R. 2584.)

On the trip upstream got out and push the boat off sand bars a great many times; the two boats had been made into two. I should say both boats were on the sand bars a great many times, or hampered by other obstructions or where the current was too swift to handle them. (R. 2584.) This change in the boats was made about the third day. (R. 2585.) His impression is that the Utah line is about at Warm creek, somewhat below the Crossing of the Fathers; their change would have been made there a little below or a little above there, not a very great distance. Most of the section of the river in Utah was made with combined units; were a better operating organization by this arrangement than when we were all barging ahead on our hit and miss. Now had Tom and Andy Wimmer at the only working motors, and both were good men with the engines; were able to concentrate efforts if the boat got in trouble; had three men to work with it, a man to row as hard as he could, or go overboard and tow from the bank, or tow from the water if that became necessary. It was an unwieldy thing, but were getting fairly good results. As a boat it was more difficult, but they concentrated three men on it; there was a unity of effort, and the advantage was from that rather than from increasing the length of the unit. A larger boat is normally much more unwieldy, of course, crossing a current. The

lashed boats would swing with them, occasionally take them back down the river; that happened in a good many instances. (R. 2585–2586.)

He was not able to give any estimate of the number of times the boat stuck between Warm Creek and Hall's Crossing. That would be like estimating the number of automobiles we passed coming from the hotel; from one thing and another we were stuck or stopped a great many times. It might have been from sand bars, from rocks, or from the current. (R. 2586.) In his own case once, navigating alone, stuck on a pinnacle of rock—that was when he was navigating alone before they were lashed together. This is illustrative of the difficulty of reading the water of the Colorado, on account of its complete opacity. There was nothing to indicate the rock beneath the water. He ran the middle of the boat on to the obstruction; stepped out to lift it off, and found himself in water over his head; when he tried to lift it, he was swimming. Does not know whether he got off alone, or whether some one came and helped him off. (R. 2586–2587.) The stage of the Colorado River at the time he was there was; roughly it was a moderately high August stage, about ten or twelve thousand second-feet; that would not be very far wrong; it could be checked from the record of flows which you have. That is a very rough guess. (R. 2587.)

After reaching Halls Crossing they waited there until the other party came, about a week later.

They started the trip on the 17th of August, and got to Halls Crossing,—Roughly, about twelve days. It is possible one day of that was for a trip we made up to Rainbow bridge, which would give us eleven days' navigating. If that is correct, averaged slightly better than ten miles a day; practically daylight to dark work. Were waiting nearly a week. During that interval took one boat voyage with a single boat and four of the party up the canyon; went ten miles further, through a rapid called Bull Frog, which was somewhat rougher and steeper, than in Glen canyon, below; then went up to a creek with some interesting cliff dwellings, passing an old dredge that had been abandoned in the river. That was the farthest point touched. Shortly after returned, the party for which they were waiting came in. (R. 2587–2588.)

On the down trip they hit occasional groundings and sand bars.

Between Hall's Crossing and Warm Creek they had more groundings on the way down than they did upstream; "we were a little more heavily laden, but nothing like the continuous delays and troubles we had from currents, rocks, break-downs, and other difficulties on the up river trip. We had the current with us.

Even the engine would fail for several hours at a time, and everyone would take the oars and keep the boat in the current and it would keep going. Sometimes it would be up against a cliff. There

were occasional groundings on sand bars. The river was a little lower then. (R. 2588–2589.)

One unit of the boats was in charge of Andy Wimmer and the other in charge of Tom Wimmer; he was with Mr. Wimmer on the down trip, and there were two other boatmen with Andy Wimmer; Tom and he had the running of the one craft. One of the men had gone out from Hall's Crossing; there were only five.

Something like a week was spent on the river, going down to Lees Ferry, made stops at the San Juan; made the surveys which mentioned; there was a stop at Rainbow bridge, and another stop at Warm creek, where crawled out to the mesa and located one or two points on Father Escalante's route; also at the Hole-in-the-Rock, where the remarkable Morman migration crossed, the point where the wheel vehicles were taken over the cliffs. (R. 2589.) There is a great deal of sand and silt below the San Juan because that river brings in a great amount of it. (R. 2590.)

A sand wave is a wave very much sharper than the ordinary undulation of the surface, due to the fact the water has a very much higher sand and silt content than under normal conditions; possibly at times this is as great as fifteen to twenty per cent by weight, giving an action very different from that of clear, flowing water. (R. 2590.) There were evidences of sand wave condition the morning of the heavy flood above Rainbow Creek, not nearly as

heavy a sand wave as one would see on the San Juan or as he has seen on the lower river, below the Grand Canyon. (R. 2590.) There was a four or five-foot rise of the river that night. One of the party had his bed completely surrounded by water where he slept on the bank. There was a considerable rise on that occasion. Noticed that in wading the rapid the next morning there was a more broken condition of the water than with the ordinary silt content. That is the only thing he recalls approaching a sand wave on that trip. (R. 2590–2591.)

He has seen sand waves on the river at other places, the largest being below Grand Wash, near the conclusion of the Grand Canyon voyage in 1923; were navigating very carefully, even with these specially-constructed boats they used through the Grand Canyon. Down there the heighth of the sand waves roughly might have been three or four feet. He has not seen them higher than that. Neither has he seen them actually breaking. (R. 2591:) The way they break, forward or backward, would vary a great deal according to the silt content, also the wind, both would affect it, and a boat being propelled through them would have the effect of making the waves break over the bow. The weight of the sand makes them dangerous. (R. 2591–2592.) He has no recollection of seeing the sand waves on any other rivers.

First heard the term "sand wave" used in connection with the Colorado—probably from one of

the engineers of the survey, speaking of a voyage on the San Juan. (R. 2592.)

Some differences in the channel were observed between the up-trip and the down. The channel of the river would be the point you would navigate, where the deeper water is. The rate of change is affected greatly by the amount of the flow. A heavy flow will facilitate the movement of the sand; it would shift a sand bar according to the way the current deflected by this or that wall strikes it. That is inseparable from any sand-bearing river. (R. 2593.)

He did not make any specific observations as to the location of any change in the channel between the upstream trip and the downstream trip, occasionally remarked that the channel was changed here and there, or had moved this way or that, or might have said, "We are encountering shallow water where we found it deeper." One takes that as a matter of course with any sand-bearing rivers; you get it anywhere, except this is a little worse than any he knows of. (R. 2593–2594.)

After returning to Lees Ferry the party went out to Flagstaff; "Mr. Davis and Mr. LaRue and five or six of us went to the Diamond Creek dam site, came out from there, circled around, and went to the Boulder Canyon dam site; came out at the Needles; then went on down to the delta and the gulf on a little jaunt of his own account. (R. 2594.)

This expedition disbanded at Lees Ferry; his trip through the Grand Canyon was the following year, with the Geological Survey expedition under Colonel Birdseye; he was boatman on that expedition. (R. 2594.)

Cross-examination (R. Vol. 14, pp. 2594–2597):

The horsepower of the Evinrudes that they used was three or four, and the Elto was three horsepower.

When they were going upstream in tandem form, having one engine to each of two boats, there were two engines that were still in commission, Evinrudes. "My Elto had gone and one Evinrude was gone." That is all the power they had on that upstream except man power. (R. 2595.)

The trip down from Hall's Crossing was very much easier and simpler and was attended with less obstructions and difficulties than the up trip. That was on account of the presence of power going down in our favor rather than the power of the river [against us] going up; just the difference the current makes, inseparable from all up and down stream navigation. (R. 2595.) He has not been on the Colorado River at Moab.

Difficulty of cooling engines has been overcome, as far as the pump is concerned. The grinding action of the gears and other parts is still a difficulty to be reckoned with. It is employed by prac-

tically all types of out-board motors at the present time. A cup carries the water up by the force of the stream from the propeller and this cools the cylinders. The out-board hasn't a radiator.

With clean water you would have no trouble with scouring where the clean water was in contact. Where you were in contact with the scouring silt on other parts you would still have the difficulty arising from the fact that the Colorado silt is probably sharper than any other stream, and would inflict considerable damage to other parts. You eliminate only the pump trouble. (R. 2596–2597.)

Further examination (R., Vol. 14, pp. 2597–2599):

There is a difficulty from the silt in the river in connection with the operation of an engine used with paddle wheels on a boat which I am not technically able to explain, but which is present on the Missouri and Mississippi to a certain extent on certain types of engines.

He knows they were attempting paddle-wheel navigation from Lees Ferry, and has heard something about an attempt to operate the tunnel-propeller type boat. (R. 2597–2598.)

His definition of a rapid is a broken stretch of water existing either as a result of rocks or the speed of the river or a very sudden declivity, very steep declivity. (R. 2598.)

HERMAN W. FREEZE

For Complainant

(Record Vol. 14, pp. 2599–2621)

He resides at 6130 Delphi Street, Los Angeles, California. His occupation is deputy sheriff. Employed in 1911 by American Placer Corporation of Chicago as superintendent of machinery; company operated at Lees Ferry. Machinery was brought to Lees Ferry by freight, via Flagstaff, some from Paria down from Marysville. The company owned a boat, built at San Francisco, which was freighted in in sections; called *Charles H. Spencer.* (R. 2599–2600.)

Compl. Exh. 415, a photograph of machinery at Lees Ferry. (R. 2601.)

Boat *Charles H. Spencer,* 80 to 100 ft. in length; equipped with steam power and a paddle wheel; built to transport coal to camp. (R. 2602–2603.) Coal mine understood to be up river at Warm Creek. (R. 2603.)

Exh. No. 11 D, photo No. 296, looks like the boat on a sand bar. (R. 2602.)

Compl. Exh. No. 416 is a photograph of boat *Charles H. Spencer.* (R. 2602.)

Boat made three trips; 1st trip had 3 or 4 tons of coal on front of deck; 2nd trip, a little more; 3rd trip, about 15 or 20 tons; coal to be used for firing boilers for pumps at Lees Ferry. (R. 2603.)

Mining machinery operated on and off about 3 months altogether; did not have fuel to operate con-

tinuously; used driftwood out of river; pumps pumped water and air for pneumatic dredge. (R. 2603.) Tried to save the gold from the silt of Colorado River. (R. 2604.)

Company had two little launches, a Mullin boat; also a row boat. First boat was to be used to bring coal down on barge, but could not make trip up river with it; other launch used to get wood and so forth. (R. 2605.) He left Lees Ferry in September, 1911. (R. 2606.) Left by wagon.

Supplies at Lees Ferry brought by wagon. (R. 2606.)

While he was at Lees Ferry no supplies from either up or down river. Saw no other boats excepting their own, but small rowboat of Kolb Brothers.

At Paria, had the same kind of mining operation as at Lees Ferry. (R. 2607.)

President of company, Dr. Robert A. Parkin, of Chicago. Company did not operate after he left Paria about 12th of December, 1911. Does not know what became of boat *Charles H. Spencer.* (R. 2608–2609.)

Observed a flood on Colorado; boys measured it and said rise was 26 ft. Had to get pumps out at eleven or twelve at night to get them away from flood; next day cows and sheep dead and timber came down the river. (R. 2611.)

Compl. Ex. No. 417, photograph of wagons waiting to cross Grand River at ferry.

Built a new ferry; had lost a team of horses and a man drowned; ferry was strung on a cable, operated by Mr. Johnson. (R. 2612.)

Cross-examination (R., Vol. 14, pp. 2612–2616):

He went to Lees Ferry early in the spring of 1911, and he left there about the first of September. He was in there about three months. (R. 2612–2613.)

The *Charles H. Spencer* boat was built up above Lees Ferry while he was there. They were hauling the stuff in at the time he was at Paria. He didn't see it launched. It might have been a week or two after it was launched that he saw it. He recalls that the boat made three round trips from Lees Ferry up to Warm Creek. He was not on any of these trips. He was never in Warm Creek; never at the coal mine.

On the first of the trips it looked to him as if there were three or four tons of coal brought down. He doesn't know the width of the *Charles H. Spencer,* probably sixteen feet, something like that; wouldn't say, really don't know; don't know the exact length of it either. (R. 2614.)

They brought a little more coal on the second trip than on the first one. He would not say it was two or three times as much; think they had about five or six tons the second time; there was a little larger pile than they had the first time. The third time they had the front, the nose of the boat,

pretty well covered with coal; judged about fifteen or twenty tons. They brought this fifteen or twenty tons about a month before he left. (R. 2614.)

Mr. Charles H. Spencer was there when he left.

At Paria he had charge of the amalgamating since they were shut down at the Ferry, we were operating at Paria; went up there before he was called in at home. (R. 2615.)

Mr. Charles H. Spencer was one of the starters of the American Placer Corporation. He has not seen him in the courtroom during the progress of this hearing. He hasn't seen him for years. He [the witness] has not been here until to-day, and does not know for certain that Mr. Spencer lives in Los Angeles. (R. 2615.) He has no recollection of either of the two launches making any trips.

He did not say whether they did or whether they did not make any trips, and he knows nothing of whether Mr. Charles H. Spencer or other persons made trips up to the foot of Cataract Canyon. (R. 2616.)

Redirect examination (R., Vol. 14, pp. 2616–2617):

He was at Lees Ferry when the machinery was first started.

He had nothing to do with superintending the firing of the boilers or the maintenance of steam. (R. 2616–2617.) They had a foreman there in charge by the name of Thornton. That is so long

ago he doesn't really know. They changed quite a number of times around there. (R. 2617.)

Not necessary to use steam except to get water for the washing through the sluices, to bring the sand in there, anything like that. (R. 2617.)

Recross-examination (R., Vol. 14, pp. 2617–2618):

He does not know the diameter of the paddle wheel on the *Charles H. Spencer* boat, but it was operated by a stern paddle wheel.

On the three trips that the boat made he believes they took some food up there for the miners at the camps. He doesn't know how many men were in the crew of the boat; he judges about five or six. (R. 2618.) That picture was taken right at the sand bar at Lees Ferry; some of those boys may have climbed on the boat; don't know; don't remember that—when that picture was taken. (R. 2618.)

FRANK J. WEBER

For Complainant

(Record Vol. 15, pp. R. 2624–2647)

He resides at Hanksville, Wayne County, Utah, and is sixty-four years old. (R. 2624.)

He has been on the Colorado River for a total length of about forty-five miles from Dandy Crossing.

He was on the Colorado River November 4th, 1891, having gone there by way of Bluff from Ouray, Colorado, with a pack outfit, down the

White canyon and landed on the opposite side of Dandy Crossing. (R. 2625.) There were three in the party, and had four animals. (R. 2625.) He stayed on the other side of Dandy Crossing all night; that evening when landed there, stayed there that night, and the next morning there was Homer Hite on the other side of the river; he had a boat there; he told me to come across, he towed them across—rowed across; towed the animals behind the boat and landed on the right side. That day he went right on down to Hite; turned the animals loose on the bar and went down in that boat down to Good Hope. (R. 2626.) They just used a row boat with two oars.

He remained on the Good Hope bar where he was placer mining the remainder of 1891 and until about June or July in 1892. He used no boats in connection with the placer mining.

He never took any boats upstream. (R. 2626.) He has seen other men take boats upstream; does not know how they got along; he did see them leave the placer mine; he knew they went up after supplies and then came back with them, "and I see them start out from the camp, but I wasn't with them; I don't know how they got up." He did not make any trips himself in the boats. (R. 2627.)

During the three years in there did not see any supplies brought in on the river either from below at Lees Ferry or from above at Greenriver, Utah.

They got supplies [overland to the river] from Greenriver and through Richfield sources and on down to the Dandy Crossing, either through Crescent creek or else down through Trachyte creek, and landed them on the river. (R. 2627.) The supplies were then put on skiffs and brought down to the camp.

In connection with operation in and about Hansen Creek they used a scow, about a seven-foot bottom, twenty or twenty-two feet long; they used that to get the stuff over to the bar from the land, across the river. The scow was operated with two oars; it took one man to each oar to manipulate the thing; then there was a third party on the stern end; he was steering it along, to hold a section, or whatever you call it, right side up with the stream; just kept pulling; we had to go around an island. (R. 2628.)

Good Hope Bar is on the left-hand side as the river flows, a trifle above the mouth of Hansen Creek about mile 130, or about thirty-six miles from Dandy Crossing to the California Bar. (R. 2628–2629.) There is an island near this bar. The bar itself is not an island; that island is up the river. The workings was all on the other side of the river, on the left-hand side of the river, and there was an island between where they worked and where they landed the stuff; that island was three-quarters of a mile long. (R. 2629.)

He was employed by Mr. Stanton at the camp known as camp Stone, which was located about nine

or ten miles below the California Bar, probably straight up about a quarter of a mile from the mouth of Hansen Creek, extended on up the river for half a mile or so; had to go around that in order to get to the workings. (R. 2629.) They were building the dredge on the right-hand side of the river. He had charge of all transportation in connection with the Stanton dredge; everything that went on that river from Greenriver, from the shipping point down to the bar and down to the dredge. The machinery and equipment was brought in under his supervision.

Supplies were obtained from Greenriver, Utah, and were freighted down to the Colorado River by wagon. (2629–2630.) Had seventeen wagons, the company owned, and seventy-two head of horses, and we had five stations along this line between Greenriver and the landing place that we called feed stations; and he contracted hay and grain for those camps in order to feed our animals as made a day's drive, and had a man stationed to receive all freight.

This freight came from Greenriver to Hanksville on the wagon road. And then from Hanksville got it over to the river the same way. From Hanksville go over the mountain with it, a pass between Middle mountain and South mountain, and we go on down what is termed Indian Creek bench on down to the Coal Mine mesa, and down to Kane springs, over a sand knoll over into—we used to call it Wilson jump-off.

That is an awful rocky ledge, and the company built a road down in there in order to get down. When we got to that point there was cables stationed there, and windlasses; if we had heavy loads, for instance, six or twelve horse loads, long stuff, we protected it by this windlass and let it down easy; it was an awful rocky ledge; it was steep, too; we got it down to the landing place. That is the only place we came down over, down into camp Stone; didn't come down any creeks or gulches at all. In other words, almost fall off a ledge there; built a place to get to it. (R. 2630–2632.) Wilson ledge is about forty-six miles from Hite. He believes it is three miles above Bull Frog Rapids. The road that was built was just at the particular place on the ledge. The Hoskinnini Company, that was the title of that company that operated down there that dredge, they improved the road, made improvements on the road in order to get down. (R. 2632.)

He does not believe that there was a road from Hanksville down to this point on river prior to when the improvements were made. (R. 2632.)

There are ranches and camps along the mountain; there has always been a road as long as he knows to get to those ranches, but the roads are in the nature of cow trails. It was on these trails that the supplies used in connection with the operations in the Colorado River came from Hanksville; the supplies such as eatables and so on, a good deal of that came in by way of Richfield, and on down that

way, and all machinery and everything else came by way of Hanksville, everything was shipped from Greenriver, but there is a good many of the supplies, eatables and so on, came by way of Richfield and on down through there, but don't know anything about that line. (R. 2633.)

In 1899 he helped build a scow for the Hoskinnini Company which was used to load on heavy machinery from the landing place to get it to the workings, the dredge, that is the only way they had to get it there; the boat had to be quite a ways from the shore in order not to drown it from the turn loose. (R. 2634.) When he brought the scow down there and loaded it with driftwood they had difficulty getting through the river on account of sticking on sand bars. After they built it launched it a little below Dandy Crossing, and we went on down the river, and as they went down they gathered driftwood and put it on this scow, and when got about seven miles below Dandy Crossing—not Dandy Crossing, but Good Hope—grounded; was trying to get loose; was detained there about half a day, four of them; finally got her off and went down a little ways further, about three or four miles maybe, and experienced the same thing, and it was getting dark then so camped there that night; and the next morning got it off and went on down to the dredge. (R. 2634–2635.) The raft when first put in the water drew about six inches empty, and loaded about fourteen or fifteen inches.

He saw Mr. Stanton's dredge in operation. Stanton continued to operate it until early summer 1901, when it was shut down. He doesn't know anything about Mr. Stanton shipping gold out of there. (R. 2635.) They commenced constructing the dredge in 1899, and he doesn't believe they operated more than two or three months. (R. 2636.)

Cross-examination (R., Vol. 15, pp. 2636–2641):

He went to the river on the fourth day of November, 1891, at Dandy Crossing and on the fifth of November, 1891, went down to Good Hope Bar and stayed there on the bar on that occasion until 1892. (R. 2636.) He can not tell the date when he came away from the river; he was out and in most of the time he was working there; they sent him out for something, and then in again and out again; couldn't recall that, that has been too long ago. (R. 2636–2637.)

He was on and off the river up to 1894; then he came out and got married in 1895. He stayed there, then worked on and off for different parties just a little while at a time until Mr. Stanton came in with his dredge. Then he was employed by him.

While he was there working on the Good Hope Bar he saw men go up the river and later come down with supplies in their boats.

The scow used during the time he was on the California Bar had a seven-foot bottom, about twenty or twenty-two feet long. (R. 2637–2638.)

It hauled coal and anything that they had to have to operate the camp; it all went around that island. The coal carried around that island in the scow ran as high as three thousand [pounds]. The coal was used to supply the boilers on the other side [of the river] for that mine. The coal came from a point between the Henry Mountains and the river, just about half way. There is a coal vein in there they call a Coal Mesa, and Mr. Goss, the one he was working for, he contracted coal to be hauled or shipped that he dug from that place down on to the California Bar; a fellow named John Chris had the contract; he had ten or twelve burrows; he would pack it down to Hanson Creek. (R. 2638-2639.) Then it would be loaded in the scow at the landing place and taken around the island to the mine. The road from the coal mine to Hanson Creek was not a very good one. A wagon probably went down there once a year; it is pretty rough country through there. Approximately the coal was hauled seventeen miles from the mine to the mouth of Hanson Creek.

The scow that he helped to build in 1899 had a fourteen-foot bottom and was twenty-eight feet long. (R. 2639.) On one trip when he was carrying drift wood he got stuck in the river about seven miles below Good Hope Bar.

When he got the scow off the bar he shoved it off into deeper water. Don't know anything about deeper water there. He might have wanted to

dodge some rocks in order to get through the channel, but anyway they were stranded there; was half a day getting off; finally got off, and drifted on down.

Just as he said, the channel he was used to going, might have been obstructions there that he tried to avoid, and probably got a little far off to one side; couldn't say about that, because he is not versed on boating. (R. 2640–2641.) After they got off they got the scow in deeper water.

The second time, the other time he got stuck, was just a little ways beyond that, but it was not so serious; it was getting late; stranded there; didn't make any effort to get off that night, so camped right there on the scow and stayed until morning, then shoved her off and went on. The next morning when they shoved it off there was enough water to float it. (R. 2641.)

Redirect examination (R. Vol. 15, p. 2642):

The trip with the Stanton scow was made in the midsummer of 1899, somewhere about the latter part of July or the fore part of August. (R. 2642.)

Further examination (R., Vol. 15, pp. 2642–2644):

When he first came into that country he went from Ouray, Colorado, by way of Bluff, San Juan County, Utah, and on to the Colorado River. He got from Bluff to White Canyon with pack outfits. There was a dim road there; you can distinguish it here and there along the line, what they call the

Old Mormon trail, we went by. The difficulty is to get water. The road is so badly obliterated we had an awfully hard time finding watering places for our stock and ourselves, too. Some places had to go down steps; there is Indian steps they chipped in the rocks; you go down and pull up a bucket of water and give it to your animals. (R. 2643.) It took two days and one-half to go from Bluff to the Colorado River. The crossing at the foot of White Canyon is a recognized ford across the Colorado River; that is where all the travel went between the two counties; had occasion to go that way; they had quite a good-sized boat there, they ferried across the whole outfit, even large enough to put on a wagon and team and all to put across. (R. 2643–2644.)

A fellow named Cass Hite owned the ferry at that time. The boat was probably twelve feet wide, nosed in front, and about thirty feet long. It was rowed across the river. (R. 2644.)

Recalled for Further Examination (R., Vol. 15, pp. 2646–2647):

He has been living at Hanksville since 1895; sorry to tell it, there was a population of about one hundred and twenty-five, one hundred and fifty people there when he got in, and it is rather decreasing instead of increasing since; probably one hundred left now. Hanksville is termed sort of a junction; you come in from the west and you come in from the north and all of it has got to go through

Hanksville to go to the south and to the east; there is no other way out. (R. 2646.)

The road to the north from Hanksville leads to Greenriver. There is no other road or places to the north. The road to the west leads to Loa, the county seat and on to Richfield to the railroad. That is the State road from Hanksville to Richfield. There is no road from Hanksville to Escalante. (R. 2646–2647.)

GEORGE D. D. KIRKPATRICK

For Complainant

(Record Vol. 15, pp. 2645–2722; 2822–2828)

(Record Vol. 18, 3386–3393)

He resides at Salt Lake City, in charge of Public Survey Office, Dept. of Interior. (R. 2645.)

Educated at Cornell and George Washington. Has been with Government since 1903.

Manual of instructions for Survey of Public Lands of United States is an official document and contains directions as to manner of making surveys. (R. 2648.)

Sections 226 to 232, inclusive, of the document are copied into the record. (R. 2649.) "226, Meandering." (R. 2650–2651.) "227." (R. 2652.) "228." (R. 2654.) "229." (R. 2654–2655.) "230." (R. 2655–2657.) "231, Rivers." (R. 2657–2658.) "232–Lakes." (R. 2658–2659.)

He has charge field and office work in relation to Public Land Surveying, in states of Utah and Nevada.

Colorado River, locality of Moab, crossed there in 1915.

1917 operated just west of Colorado, north of Utah-Arizona state line, from Paria river almost to Colorado; north of state line about 12 miles. (R. 2660.)

Country, very rough broken country, sparse growth of vegetation; fit for grazing only; very little agricultural use; few little ranches. (R. 2661.) No permanent residents east of Paria in 1917; rode horseback to shore of Colorado and back to camp. (R. 2661.) Survey party there six or eight months. (R. 2662.) Supplies hauled by wagon from Kanab, and transported by pack animals. (R. 2662–2663.)

Up Green River on east side, from Greenriver, in 1920, about 40 miles to McPherson's ranch; six or eight miles on east and west sides of river is agricultural country; project abandoned. (R. 2663.)

Country very rough and broken, high ledges and cliffs; ledges come right down to river.

McPherson's ranch a little irrigated land, possibly 100 acres. (R. 2664.) Ranch in canyon along the river. Supplies brought to party during work from Greenriver.

On Green River in 1923, in locality of Flaming Gorge. (R. 2665.) Went by automobile from Green River, Wyoming, left auto at camp on Sheep Creek, four or five miles from river. (R. 2666.) Boat used in meander survey work along the river.

Had a small row boat, 14 or 15 long; got stuck on sand bars in the river.

Went from Sheep Creek to Green River on horseback; country very rough and broken; few small farms on Sheep Creek, possibly ten, fifteen, twenty acres.

In and about San Juan River in 1924; drove by auto from Thompson into Bluff, then down to Goodrich and on to camps on Douglas Mesa; left auto about 35 miles west of Bluff and went on horseback with pack animals to camp. (R. 2667.)

Indian trader living at Goodrich and some temporary residents around old oil camps. Mexican Hat, some men living there and at an oil well south of the San Juan. (R. 2668.)

Outfit drilling 10 miles southwesterly from Goodrich a little south of the San Juan. No production of oil. (R. 2668–69.) Most of country along San Juan, rough broken country, very little vegetation; grazing country.

In 1925 went to a point 12 miles down Copper Canyon from Moonlight trading post, 55 miles from Bluff, and 2 or 3 miles from San Juan River; crossed river and went on south side. Character of country little rougher and more broken. (R. 2670.) In 1926 traveled by auto and truck to point near mouth of Nokai Canyon, 20 miles beyond Moonlight.

Crossed San Juan River on horseback, mouth of Nokai Canyon, in November, depth of water varied from few inches to possibly a foot, with pools 18

inches deep. Observed river bed was sandy and shifting in nature. (R. 2671.) Judged the river at that point about 600 ft. wide and shallow; seemed to have number of channels that would shift.

Survey parties on San Juan River in 1924, 1925, and 1926, supplied by motor trucks, wagon, and pack animals and no supplies by boat. (R. 2672–73.)

A small sectional metal boat, 3 sections, the kind hunters use, at camp. Did not travel any place in it, just got in to test stability; boat at camp at Nokai Canyon. (R. 2673.)

He was on the Colorado River, between Moab and Lockhart Canyon, in 1926. He made a trip on river in May, 1926, in a small launch of Moab Garage Co., a black boat, about 20 ft. long. (R. 2674.)

Clarence Baldwin and Charles F. Moore in boat; took 2½ to 3 hours to make trip downstream to Lockhart Canyon, forty miles down from Moab. On sand bars a couple of times and encountered some whirlpools. (R. 2675.)

Upstream, progress was much slower, as he had to keep close to shore; went up to No. 2 well and on to No. 1 well; trip of 22 miles took all the rest of the day. Going upstream to Moab, propeller was broken on a snag or rock. Beached the boat and repaired it at point above the mouth of Mill Creek, 2½ miles from boat landing. (R. 2676–77.)

The course taken going back upstream was changed from the one coming down; had trouble locating best water; river was high when he went down. (R. 2677.)

He was on the Colorado River in fall of 1926. Went from Moab to Well No. 1, about 18 miles in black boat; on down to well No. 2, 8 miles farther, with 16-ft. rowboat and outboard motor; black boat was operated by Clarence Baldwin and the outboard motor was operated by Mr. Swanholm. Going down stream in black boat he was held up a few minutes sticking on bars. River much lower than when he was there in May; and when meandering below Moab stuck in mud a good many times. This was latter part of September and early October, 1926. (R. 2679.) He assisted in survey work and crossed river eight or ten times; crossed at points commencing 6 or 8 miles below Moab and running down 8 and 10 miles.

Observed that channel changed a good many times during three or four days.

On the Colorado River again in November of 1926 from Moab to No. 1 well in black boat of Moab Garage. (R. 2681.) Operated by Clarence Baldwin.

Returned upstream from No. 1 well to mouth of Millereek on large barge of Moab Garage; got stuck at Millereek and stayed all night; he waded ashore or went in a small boat. Baggage left on barge had not reached Moab at 11 o'clock following day. (R. 2682-83.)

Major portion of supplies to survey parties on Colorado River was transported by trucks or wagons to camp and then on pack animals; some carried down river by small boat and by Moab Garage Company. (R. 2683.)

Point 7 or 8 miles down river from Moab, east or left side of river; a ledge country, very rough; vegetation sparse up side of rocks; some of ledges devoid of vegetation. Along river some brush and a little grass and forage for stock; saw no one below Moab who lived there.

Other point out of canyon; no inhabitants; country very rough and broken. (R. 2683–2684.)

He explains meander line, as surveyed line by courses and measurements along mean high-water mark of a body of water and how mean high-water mark determined. (R. 2688–2689.)

Survey instructions describes just what bodies of water should be meandered—and reason why such rivers as Colorado, San Juan, and Green are meandered. (R. 2691.) Meander surveys made in conjunction with subdivisional surveys of public land. (R. 2692–93.)

Cross-examination (R., Vol. 15, pp. 1693–2721):

He knows that the Colorado River as far as the public land survey has extended has been meandered and this is true of the Green River where the public land surveys have touched that river. (R. 2693.) He doesn't know the conditions of all the

surveys along the San Juan and while he was in charge of the San Juan just as much as the Colorado River some of the surveys may have stopped at the river and not been meandered. The only way he could tell this would be to get all the plats, but as far as he knows the meander has taken place whenever the public survey has extended to the San Juan River. (R. 2694.)

When one of his parties was making survey twelve miles north of the Utah-Arizona line in 1917, he rode from where the men were surveying over to the river and at that point he would estimate that the survey came within probably twelve miles of the Colorado River. (R. 2695.)

He knows that there are some veins of coal in that vicinity. The ones that he saw were probably thirty miles from the Colorado River. (R. 2696.) He has also seen a pile of coal on Warm Creek that might be three to five miles from the Colorado River. (R. 2697.)

He doesn't know where the dam crosses the Green River with reference to the town of Greenriver. He doesn't know anything about the dam. (R. 2697–2698.)

He is familiar with a strip approximately three miles wide extending up above Greenriver, Utah, about forty miles. The trail goes up on the east side. (R. 2698.) He states that by observation from places you can see three or four miles on both sides of the river. He was only up in that particular locality once. (R. 2698–2699.)

He has been in the Uinta country, but on his direct examination when he stated he only knew of a few small farms on Sheep Creek he was speaking with reference to the mouth of Sheep Creek and probably two miles below and as far up as the Flaming Gorge dam site. (R. 2699.)

He states that on direct examination he may have testified that when he visited the San Juan River in 1926 that it was late in the fall, probably November, but he believes that it was in the spring of 1926, March or April, and he recalls stating that on his other visits he had not seen any boats with the parties; that when he visited this party on other occasions they were meandering the river, and he could not see the river from their camp. (R. 2699–2700.) He did not go through their baggage to see whether the boat was there or not, but as he bought the boat he doesn't believe it was purchased until after they left that country. He recalls stating on direct examination that when he crossed the San Juan River at the mouth of Nokai Canyon that the river was approximately six hundred feet in width and varied in depth from a few inches to a foot and possibly eighteen inches in pools. (R. 2701.)

He estimates that the water would come two-thirds of the way up the legs of the animal he was riding. He doesn't recall whether it was a horse or a mule but states it was a medium-sized horse or mule weighing eight hundred or nine hundred or a thousand pounds and he would estimate the legs of the animal would be twenty-four to thirty inches

long and that he looked down as he went along to see where the water was reaching.

His attention then called to the first trip he took on the Colorado River between Moab and Lockhart in 1926, when he noticed the river had shifted between the trip going down and back. He recalls that when he came back up the river the next day that the deep parts of the river were in some other place than they had been the day before. (R. 2709.) He didn't care to say there had been a complete change, as there were some places where there was no shifting; and as far as his recollection goes, the channel was the same at the mouth of Millcreek when he came back as when he went down; that there might have been a number of other places where he didn't see shifting, also, but that is the only place he paid any particular attention to. (R. 2710.)

When he came back up the river he avoided the current and kept in the quiet water and generally speaking when he went down stream he would stay in the deep part where the current was and going back he stayed out of the current as much as possible, but he still believes that the channel changes from one day to the other. (R. 2711.)

The channel is shifting for the reason that when came up the river found—found the water in better condition on a certain side than on the other, possibly when went down; recalls in going down the river at one point above No. 2 well ran aground,

ran on to a sand bar on the right side of the river; coming up they avoided that; going down assumed the best water was over there.

He doesn't recall what part of the propeller was broken, but remembers it took possibly one-half hour or so to repair it. (R. 2714.)

In the work of meandering a stream the sixteen-foot boat with outboard motor he was using would sometimes be in the middle or sometimes along the shore and would be used to cross back and forth. At times they would beach the boat and at other times went right down the river with the meander line. (R. 2715.)

It would be necessary to hug the bank as much as he could and in doing this he would sometimes touch sand.

At the time he went on the big boat in 1926 to meet Mr. Moore at Mill Creek, Mr. Moore's surveying activities were down the Colorado River east of No. 1 well between No. 1 and No. 2. (R. 2716.) He had made an appointment the day before to meet Mr. Moore at the mouth of Mill Creek. There was no dock at this point, nor was it a usual stopping place. He requested the man in charge of the boat to go ashore and let him off to keep this appointment and the boat attempted to do this. To do this the boat did not have to leave the channel. (R. 2717.) The channel went right up to within a few feet of the shore and they stuck there on a sand bar or the mud because they attempted to

land him, but that was not where they stuck all night. (R. 2718.) He got off and met Mr. Moore there and he left his personal baggage on the boat that was to be taken to the Moab landing and when he went for it later it hadn't arrived and he had to leave without it. (R. 2719.)

He has no personal knowledge of what caused the delay after he left the boat. (R. 2720.)

When he was on the San Juan River at the mouth of Nokai Canyon he doesn't believe he saw anyone with the boat during the three or four days he was there. He recalls getting into it to see if it was a very stable boat. (R. 2720.)

Redirect examination (R., Vol. 15, pp. 2721–2722; 2822–2823):

He made the trip referred to in direct examination to Nokai Canyon, April 15th to 18th, 1926. Between those dates he was at the survey party's camp at the mouth of Nokai Canyon on the San Juan River. (R. 2822–2823.)

He exhibits a memorandum that was prepared in a general way that is substantially correct as to where river is meandered. To get it exactly correct would take quite a little time, might take several days to go over all the records. (R. 2823.)

Further cross-examination (R., Vol. 15, pp. 2823–2826):

The subject matter appearing under the subtitle "Colorado River Meanders" appearing on De-

fendant's Exhibit No. 11, is a complete statement to date of all meandering of the Colorado River within the State of Utah. (R. 2824.)

The date appearing on that exhibit under the subtitle "Green River Meanders" is a complete and full statement of all meanderings of the Green River down to date within the State of Utah. (R. 2824.)

The date appearing on that Exhibit under the subtitle "San Juan River" is a complete and full statement of all meandering that has been done on that stream down to date. (R. 2824–2825.)

He does not believe there is any Piute reservation in Utah west of the 110th meridian—west of the Navajo Indian Reservation.

He does not know whether the land west of the Navajo Reservation has been withdrawn from entry. (R. 2825.)

Further examination (R., Vol. 15, pp. 2826–2827):

The surveys made south of the San Juan River and west of the one hundredth meridian, the west boundary of the Navajo Reservation, were made under a law which authorized the expenditure of a certain amount of money above the regular survey of land in which they might find oil to encourage oil development.

The survey of the land along the Colorado River is in practically all cases on the application of the State of Utah; the State applied for the survey of

about fifty townships along the Colorado River. (R. 2826–2827.)

Recalled.

Further cross-examination (R., Vol. 18, pp. 3386–3393):

There have been produced here a map and also an exhibit consisting of a few sheets indicating the area along the rivers where the streams have been meandered. Attention called to Defendant's Exhibit No. 11, consisting of one sheet only instead of two. Complainant's Exhibit No. 472 was thereupon marked by the reporter, and also Plaintiff's Exhibit No. 472. These two exhibits were prepared under his direction. (R. 3386.)

He believes that the two exhibits were prepared under his direction from official records of the Public Survey Office. The unaccepted surveys are those the surveyors executed in the field and had not finally prepared their notes and the plats had not been accepted by the General Land Office. (R. 3386.)

The plats of the accepted surveys are on file in the local land office and the field notes of the unaccepted meanders were in the survey office; plats would be prepared during the winter and then transferred to the General Land Office for acceptance.

The exhibits were executed from the working diagram which is maintained in his office and are on file there. The surveyor's field notes are also on file on all the unaccepted meanderings. (R.

3387.) These field notes are in 50 or 75 small books and are the notes taken in the field in rough draft. The field notes will be prepared according to special instructions together with the plats, and sent to the Commissioner for acceptance. The official field notes will contain no different matter as far as actual surveys are concerned. (R. 3387–3388.)

There are no other meanderings on either of these rivers, either official or unofficial, that are not shown on Defendant's Exhibit 11 and Plaintiff's Exhibit No. 472. No meanderings that have been executed by the Public Survey office; everything they have done is shown on that map. (R. 3389.)

He states that he does not know if meanderings are executed by other departments of the Government. (R. 3389.) He knows that the Geological Survey has surveyed the rivers but doesn't think they meandered it according to the system of the Public Survey Office.

The Geological Survey map is a topographic map of the rivers, but it is his understanding they made no attempt to fix the meander lines. (R. 3390.)

CHARLES F. MOORE

For Complainant

(Vol. 15, pp. 2723–2760)

His headquarters are at Salt Lake City. His occupation United States Surveyor for G. L. O. (R. 2723.) One year in Colorado Agricultural

College; in Government service since 1917, and has done surveying work in and about the Colorado and San Juan Rivers.

San Juan River; first there in 1923; went in from Bluff to Oljato Springs, 12 or 13 miles southwest of Goodrich. (R. 2724-2725.) In charge of party of 14 men; went in by wagons, and came out in the early summer of 1924; survey commenced on range line between townships 37 and 38 and ran west to west boundary of township 41. (R. 2726-2727.)

He found the country sandy, with a great deal of surface rock.

A family at Moonlight trading post and one homesteader a mile below were the only people he knows of living there, outside of Navajo Indians. (R. 2727.) Vegetation sparse.

He has been on San Juan River to canyon at mouth of Slick Horn Canyon and down along from Clay Hill Crossing. (R. 2728.)

He was also on the San Juan River during winter of 1925 and 1926. Vicinity of Copper Canyon, and along river 12 miles up in 1925. Survey in 1925-1926 covered from mouth of Moonlight to below Piute Canyon. (R. 2729.)

Attempted to use boat in crossing with some supplies, crossed once or twice, crossed on horseback daily. (R. 2730.) Crossed at mouth of Copper Canyon, Nokai and Piute Canyons, also above Piute Canyon. Sandy crossing, at mouth of Piute Canyon water came up so he had to hold feet up out

of stirrup but other places it was below. (R. 2731-2732.)

Has waded across San Juan River and judges the depth to be from six to eighteen inches.

The party was supplied by truck, wagon, and pack train, when working approximately 75 miles from Bluff. (R. 2733.) Never received supplies by boat. Outside of the boat he had, he never saw any other boats on river; boat he had was brought down to use with crossing supplies; used once or twice. (R. 2734.)

Supplies taken over by pack animals. (R. 2735.)

Observed sand waves on San Juan; would run four ft. high, generally in April. (R. 2735.)

He has been on the Colorado River on government surveys from mouth of Castle Creek to ten miles below Lockhart. Both upstream and downstream in a boat on section between Castle Creek and Moab. (R. 2736.)

August, 1928, had a 16 ft. boat with outboard motor belonging to Moab Garage Co. and came upstream approximately five miles to rapids at Big Bend. Did not think it was safe to take boat through. (R. 2737.) Went up to Salt Wash and Castle Creek on horseback after leaching boat.

Borrowed small home made rowboat 10 or 12 ft. long, 3 ft. wide from ranch at mouth of Castle Creek.

Between Castle Creek and Big Bend found rapids. (R. 2738.)

Wagon road follows Colorado river from Moab to Castle Creek.

He also has been on the Colorado River from Moab bridge down stream to 10 miles below Lockhart. Trip made in May, 1926. (R. 2740.)

Black boat of Moab Garage was operated by Clarence Baldwin. Few whirlpools and water extremely slow. (R. 2741.) Had a camp at Ming's Bottom and brought in supplies at times on barge, but rest of time by pack train.

Established a camp between Nos. 1 and 2 wells; supplies came on pack animals on Moab Garage Barge. (R. 2743.) Supplies brought down on barge very uncertain.

Mr. Swanholm camped at No. 2 well; would sometimes bring supplies in outboard motor; sometimes left at dock on left-hand side of river at No. 1 well and he would get them by pack train.

Crossed Colorado River in an outboard motor boat. (R. 2744.) Has seen Mr. Yundt's party ford the river; when fording in a rowboat would turn animals loose and they would swim across river.

Has seen Moab Garage barge passing, but has not made a trip on it. (R. 2745.)

Later had a camp about 3 miles from Colorado River in neighborhood of Lockhart Canyon; supplies from Moab and Monticello came through Indian Creek by truck, wagons, and pack train.

Trail on left side of Colorado River from Moab to Lockhart Canyon. Country very rough, broken,

and ledgy. No inhabitants and used principally for winter grazing. There is a scarcity of water. (R. 2746.)

Cross-examination (R., Vol. 15, pp. 2747–2759):

Survey south of San Juan started at west boundary of Navajo Indian Reservation.

Supplies actually reached him to camp on water's edge, San Juan River, at Nokai Canyon. He had another camp at mouth of Piute Canyon, supplies overland between the camps. (R. 2748–2749.) When he camped at Copper Canyon, supplies from Bluff, Kayenta, and Moonlight trading post by wagon and truck. R. 2750.) Recalls no instance on river when supplies were taken down San Juan River by boat; supplies were taken across river at camp at Nokai. (R. 2751–2752.) Never took supplies by boat between camps at Nokai and above Piute. (R. 2752–2753.)

His most westerly point survey touched the river approximately two miles below mouth of Piute Canyon. (R. 2753.)

Piute Canyon comes into San Juan River, down stream from Piute Farms. San Juan flows through a canyon between Nokai and Piute Canyon, and enters canyon again below mouth of Piute Canyon. There is a low, rolling, broken country just above mouth of Piute Canyon. (R. 2754–2755.)

San Juan river varied from six inches in shallower parts to 18 inches in main channel; spring

of year; at Nokai. He has crossed river on horseback, on foot and has waded from side to side numberous times. (R. 2757–2758.)

Redirect examination (R., Vol. 15, p. 2760):

He has a ranch fifteen or twenty miles from Westwater up Little Dolores River. (R. 2759–2760.)

ROBERT C. YUNDT

For Complainant

(Record Vol. 15, pp. 2761–2799)

He resides near Blanding, Utah, and is a surveyor for General Land Office. Since 1922 has been engaged in Land Office surveys in Utah, Nevada, Texas, and Oklahoma and the boundary survey in Texas. (R. 2761.)

In 1923 he made a survey near Hite, Utah, of two sections of land, which included old town of Hite.

Thomas Humphreys, Jr., was living on ranch of about 40 acres. (R. 2762.) He had a ditch from Trachyte Creek to irrigate. Humphreys had most of the land around Hite subject to cultivation. (R. 2763.)

He went from Hanksville down to Trachyte Canyon in a wagon and by pack outfit.

It was sandy country, with a good deal of exposed sand rock and small ledges. He worked four weeks on that survey. The party was resupplied by pack load from the main camp in Henry Mountains. (R. 2764.)

The only boat he saw on the river was a small rowboat belonging to Humphreys; saw no boats going up the river. (R. 2764.)

Trachyte Rapids is located just below entrance of Trachyte Canyon. (R. 2765.)

He surveyed nearly two-thirds of township near Halls Creek. The land on both sides was barren sand rock. Baker was putting about five acres of land under cultivation. (R. 2765.) No one else living there. (R. 2766.)

He made a survey of three townships near Henry Mountains. There were three small farms in there, all under 40 acres. One man had a prospect gold mine near Wolverton. (R. 2766–2767.)

He received supplies from Notom and part of his supplies from Hanksville by wagon. Notom is 18 miles west of Hanksville in Pleasant Creek locality. It is an old road, very poor, and used very little. (R. 2767–2768.)

He then surveyed on Boulder Mountain and thence to Bicknell, and disbanded. Boulder Mountain is situated west of Hanksville.

In 1924 he worked with Mr. Moore in the country south of the San Juan River, in Copper Canyon. His testimony the same as Mr. Moore. (R. 2769–2770.)

His second trip into San Juan country was in 1927 and 1928 at Clay Hill Crossing. To get into that section of the country he went from Bluff by truck, then by saddle horse to camp. Supplies were brought by pack to Clay Hill Crossing and by

truck to Johns Canyon. The survey was confined to the north bank of the river. He has never crossed the San Juan River. (R. 2770-2773.)

He worked along the Colorado River from 5 miles above Moab Bridge to several miles above mouth of Indian Creek, spending 8 months there, in 1926, starting July 30 and ending about 24th of October. (R. 2773-2779.)

He crossed the river in a small rowboat, with outboard motor. He has never crossed Colorado river. (R. 2780.) Camps were established along the river in 1926, and resupplied from time to time by pack string to camp at Island Mesa. Another camp at Grand Landing was established; supplies were brought down in Moab Garage barge. The camp was moved to Lockhart and supplied by pack string. (R. 2776-2777.) He has been down from below Moab Bridge to lower end of work above Indian Creek, and to Indian Creek in rowboat with outboard motor. (R. 2773-2774.) He ran aground on sand bars, which interfered with operation of boats in low stage of water. (R. 2774.)

He had temporary camp below Lockhart Canyon. At a lower stage of water, the channel would change and sometimes it became necessary to go away down and around a bar and come into camp from the lower side. At other times the channel above would be free and he could come almost directly into camp. (R. 2774-2775.)

He can not state how far the channel would swing; it appeared to be a progressive action, as

a rule. (R. 2775.) The channel would fail and a new one develop, necessitating a change of course. These changes occurred more frequently during low water. (R. 2775.)

He has made two trips on the Moab Garage barge. The first trip from Moab to Grand Landing, 20 miles downstream, was in August, 1926. The boat was stuck the greater part of the day on a sand bar. Carried cable ashore and used windlass; pushed and poled. (R. 2778.) Virgil Baldwin was in charge of boat on this trip which took eight or nine hours down stream. He has never come upstream on the barge.

The next trip was in August, 1927, in the same boat, when he went to Lockhart, and was hung up a short time at Big Bend. (R. 2779.)

Between Moab and Lockhart Canyon there are two patches of land subject to cultivation, known as "King's Bottom" and "William's Bottom." However, there was no one living there when he was there. There is about 100 acres of total land surface, the vegetation being mostly willow trees.

The character of the land upon the rim is rather a flat mesa, broken by numerous box canyons. He knows of no houses or inhabitants on either side of river. There were a few cows there. (R. 2781.)

Cross-examination (R., Vol. 15, pp. 2782-2792):

When he went out from that country (Colorado River, 1926) he went from Lockhart up to No. 2

well and then up river in a small boat of the Moab Garage Company. (R. 2783–2784.)

He had difficulty in 1926 with bars at low water. (R. 2785.)

There were two parties operating on the land along the Colorado River from Moab to Indian Creek, and each party had own pack train. Lockhart Camp procured more supplies overland, than by the river. (R. 2790–2791.)

Redirect examination (R., Vol. 15, pp. 2793–2797):

He had a main camp in 1928 on Colorado River at Goose Island (R. 2792) and crossed in a 16-ft. rowboat.

While he was in that section he did not see any boats going up or down stream.

On return trips to camp encountered sand bars several times, a frequent occurrence in low water.

During his work on the Colorado River he was never able to depend on a definite location of the channel, which was constantly shifting. (R. 2793–2794, R. 2795.)

He ran aground, would have to climb out and pull the boat over the bar seeking deeper water on one side or the other, if he could find it. (R. 2795–2796.)

Further examination (R., Vol. 15, p. 2797):

A rowboat with outboard motor was used going up the stream. (R. 2797.)

During the time he was at Clay Hill Crossing, on the San Juan, the only time the river was at flood stage was when they were on it. The water was too high for Mr. Moore's party to cross, being around 30 inches deep. (R. 2798.) This was in April or May of 1927. (R. 2798–2799.)

Redirect examination (R., Vol. 15, 2798–2799):

During the time that he was at Clay Hill Crossing on the San Juan the only time they were ever in the river was at flood stage; the intention had been for Mr. Moore's party to cross the river at Clay Hill crossing, and the water was too high; then the water was around thirty inches deep; he was in for a distance on the north bank. (R. 2798.)

He was thirty yards into the river and the water came up fairly close to his waist. That would be in April or May of 1927. (R. 2798–2799.)

HOWARD W. MILLER

For Complainant

(Record, vol. 15, pp. 2799–2809)

He resides at Salt Lake City and makes official public land surveys for General Land Office. He has been engaged in public land surveys since 1907. (R. 2799–2800.)

He worked on the Colorado River from August until November, 1910, from a point two miles below Westwater to Dewey, Utah—Dewey being about 15

miles south of Cisco. He was in the same country from April until June, 1911.

He has never used a boat for any purpose on Colorado River. He has forded Colorado River at Westwater and at the Cisco pumping plant, but used a ferry at Dewey, Utah. (R. 2800–2801.)

He used a pack and wagon outfit. It was not necessary to swim stock when fording.

The river runs through a canyon filled with rapids and is very swift. (R. 2801.) East of Cisco pumping plant, however, the river runs through low hill country. (R. 2801.)

The party was engaged in subdividing public lands and it was not feasible to use a boat in connection with this work. (R. 2802.)

He has been on the Dolores River, the water of which is very muddy, carrying considerable silt and sand. (R. 2802–2803.)

He was on the Green River at point 25 miles south of Greenriver, near the Wimmer and Wolverton ranches in 1911 and part of 1912. Camps were established on east and west sides of the river. (R. 2803.) The camps resupplied by team from Greenriver. No supplies were brought in by boat. Mr. Wolverton had an ordinary rowboat while on this work.

This work carried him south to the mouth of Tenmile Canyon and the south boundary of Twp. 24 S., R. 17 East. He has been over this country

from Denver and Rio Grande Railroad south many times. (R. 2804.) This is desert country typical of Dakota Bad Lands. It is filled with washes, with outcroppings of rocks, ridges, and flats. (R. 2805.)

He saw nothing on Wolverton's Ranch except a cabin. There was no land under cultivation. At Wimmer's place a cabin was about all he observed, and he does not believe Wimmer had any land under cultivation. (R. 2805.)

He crossed the Green River at Wimmer's, which is about a mile east of the San Rafael. He moved the party and equipment across. It was not necessary to swim the stock. Depth of the water was about 3 ft. This crossing was made October, 1911. (R. 2807, R. 2806.)

He saw Green River frequently while engaged in this work. Two boats of the Kolb Brothers were observed on their trip from Wyoming to the Gulf, in October, 1911, but he saw no other boats.

The country west side of river, typical desert with bad lands, clay, and shale. (R. 2807.)

Cross-examination (R., Vol. 15, p. 2808.)

He did not see Wimmer's boat during the time he was there. The boats of the Kolb Brothers were the only boats seen. (R. 2808.)

Further examination (R., Vol. 15, p. 2809):

The purpose of the survey was for the subdivision of the township into sections. (R. 2809.)

RALPH GENTRY

For Complainant

He resides at Salt Lake City, is a surveyor of Public Lands, and has been with Government since 1912.

In 1909 was on the San Juan River with government surveys. (R. 2810-2811.)

He was working from 4 miles above to 10 miles below Mexican Hat for the Chicago Exploration Company. Several camps were established. Supplies for these camps were brought from the main camp on Lime Creek, by wagon from Bluff, and to the other camps by pack animals. (R. 2811-2812.)

The party had no boats and no attempt was made to operate boats. He was at Honaker Trail during January, 1909. There were no placer mining operations while he was there.

He never saw a boat on San Juan River. (R. 2813.)

In 1914 he was engaged in government work about 25 miles down from Greenriver, on right-hand side of Green River downstream.

In crossing the river from his camp it took three days to get across. He had to travel horseback to McPherson's Ranch, where crossed in a boat. (R. 2813.)

McPherson Ranch is approximately 40 miles above town of Greenriver, and has about 50 acres under cultivation.

He recalls the country between Greenriver and McPherson's Ranch, on both sides of river, to be rolling and sandy.

Supplies were procured at Woodside, Utah, and came by pack outfit.

After leaving Greenriver country is rugged and broken by ledges and very difficult to get over. He did not see any land that could be farmed. (R. 2814.)

He was engaged in Government work at Split Mountain Canyon in 1916. He crossed Green River in a row boat at mouth of Split Mountain Canyon, which river is about 400 ft. wide. Jensen, Utah, he found to be a settlement with one fair store and probably 500 people. (R. 2815.) A camp was maintained at Daniel's Ranch, about one mile below the mouth of Split Mountain Canyon on right side of the Green River going down; supplies for this camp secured from Jensen, Utah.

The country is rugged and broken, with sparce growth of vegetation and timber. Leaving the canyon on the west, the country opens into agricultural district, with rugged mountains to the east. (R. 2816.)

He did not observe any boats on Green River other than one they had. (R. 2816.)

The river was fairly calm and deep where they crossed, but muddy. Supplies brought in to Jensen were hauled by truck from Price, Utah. His recollection of the San Juan country is that it is

the same as testified to by other witnesses. (R. 2817–2818.)

He made a trip along the Colorado River from Dewey, to Moab Bridge by wagon and team.

Cross-examination (R., Vol. 15, pp. 2819–2822):

In describing the land above Greenriver, Utah, he was not referring to the land in the immediate vicinity of the town of Greenriver. He doesn't know where the dam is.

Does not recall just how far the land is being cultivated above the town of Greenriver; for a distance of about eight, maybe ten, miles the country is fairly open and rolling. (R. 2819.) He could not say whether the land in that particular section is susceptible to producing crops if water is put on it.

His recollection of the country after you leave the cultivated portion it was very sandy soil, considerable sand, but probably for some eight or ten miles on both sides of the river crops could be raised thereon if the land was irrigated. The breaks on the left-hand side of the river are a little nearer to the town of Greenriver than they are on the other side. There is a pretty large area rolling country in the vicinity of the town of Greenriver. (R. 2820.) In giving the estimate of from eight to ten miles above Greenriver most of the land that is susceptible to agricultural use, if irrigated lies on the west. It is not so very wide to the east; you get into hills and broken country. (R. 2821.)

He observed from train going through Greenriver a large area of excellent land on the river south of Greenriver. He has never been south of the town of Greenriver. (R. 2821.)

CARL S. SWANHOLM

For Complainant

(Record, Vol. 15, pp. 2828-2845; Vol. 16, pp. 2848-2854)

He resides in Salt Lake City. At present he is United States Cadastral Engineer in the employ of the General Land Office. He has had elementary and high school training and he had one year at the Kansas University.

He has had practical experience in public-land surveys in the states of Idaho, Nevada, Utah, and Florida. (R. 2828.)

He has done survey work for the Government on the Colorado River during portions of three years, 1926, 1927, and 1928.

From about September 1st until the first part of December, 1926, he worked from a point about two or three miles below the Moab dock landing to a point approximately thirty miles downstream from there, which would make it a few miles below the No. 2 [oil well] location. At that time he was in charge of tlie party doing the meander work.

They had two camps on the river; one was just on the outskirts of Moab, another one was located about twenty-eight miles down the river at the oil well camp No. 2. (R. 2829.)

The supplies for the camp which was established near Moab were obtained from the town of Moab.

Most of the provisions for the maintenance of the other camp located downstream were all brought down on a barge; some were brought down with a little boat. During the time that he was there it was necessary for the camp to be supplied in limited quantities. During this period of 1926 the oil camps were operating probably at full capacity, and the camps were requiring the equipment to be brought down the river on the barge, and when these trips would start from Moab he would be advised by telephone when the barge would be expected to start, and if he could anticipate his needs he would send in an order for provisions for the camps, or his own camp; and times when the barge was only making a trip to No. 1 they would have to go out with their pack string at No. 1 and bring it down to No. 2 or get out with the boat at No. 1 and bring it down to No. 2. (R. 2830.)

He has made trips on the Moab barge. About the first of December, 1926, he was on the boat as he came out. (R. 2830-2831.)

During that trip there were frequent delays caused by striking obstructions in the stream, a sand bar, and they were unable to continue.

The trip on the barge started from the oil camp No. 1, which is about twenty miles downstream. And it consumed the entire day. (R. 2831.)

The usual method followed in such a situation, the only method employed on this particular trip was to back off or to pole it off by pushing against the sand bar and backing off until we struck deeper water, search around until we found a new channel, and try it again. (R. 2831–2832.)

A boat hired from the Moab Garage Company was used by his party in carrying on these survey operations on the Colorado River in 1926. He operated it almost entirely himself. The boat was used to transport them up and down the river in the regular process of carrying on the surveys in meandering lines. (R. 2832.)

It was an Evinrude boat made by the Evinrude Motor Company, about a sixteen foot round bottom boat, drawing about ten or twelve inches with a light load. (R. 2832–2833.)

In using the boat they were frequently delayed in striking sand bars; also in shearing off the propellers or striking submerged rocks close to the shore. (R. 2833.) In the operation of a motor the bearings is a source of trouble all the time in working parts of the motor that were submerged below the water, the propeller blades stirring up the sand and abrasive particles would wear on the bearings, wear off the end of the propeller; he believes it did require the replacement of one propeller blade during that 1926 season.

He made observations with reference to the changes of the stages of the water of the channel.

The lowering of the water would tend to force the water into a more definite channel. During the infrequent raises in the river, maybe a matter of a few inches to as much as a foot during this 1926 period, the water would cover the bars; when the bars are covered, it would be almost impossible to find a definite channel. (R. 2833.)

He engaged in that work in 1926 and from time to time he noticed changes in the channel. That refers to trips up and down the river where they frequently followed one channel. The changes occur sometimes as frequently as within twenty-four hours; sometimes they would hold the same channel during the whole course of the time we were there. To get off sand bars during the warm and mild weather, just went over and pulled themselves off the bar to get back into deep water again; after the cold weather came and the freeze-up in December, we were inclined to stay in the boat more, and try to push ourselves off. If that didn't work, it was necessary to get out and lift the boat off. The boat has a sharp keel and that would settle down pretty deep into the bars when you would hit them—a keel boat—not what is generally termed a keel boat, but it has a projection that extends about three inches below the bottom of the boat; it is not a weighted keel, however; a hard wood projection on the bottom of the boat, into which the ribs fit. (R. 2833–2834.)

The water surveys of the river during the year 1926 in the section that he was in, would average approximately three to four hundred feet.

He has waded the river just above the mouth of Millercreek before had a boat available. (R. 2834–2835.) The maximum depth at that time was about thigh high. The current at that time and place was about probably five or six miles an hour, not troublesome so far as wading was concerned, offers no resistance to wading. (R. 2835.)

The last of August or the first week in September, 1927, he returned to that section of the country. This was purposely done, because usually struck the low-water stage about that time. (R. 2835.)

In 1927 he came down in one of the two barges operated by the Moab Garage Company. Virgil Baldwin operated the boat. That trip was exceptionally free from any difficulties; had one or two minor delays in the nature of sand bars. On one trip he went down directly to Lockhart, about forty miles distant [downstream from Moab]. A camp was established at Lockhart; had tents there and used the oil company's cabins. His party went down with Mr. Yundt's party; the river party only consisted of about three men, including himself. The land parties on the mesas are five to seven. (R. 2836.) When he got down to Lockhart Canyon in 1927 he continued to meander the river in the same manner as before described, by the use of the

same small boat used in 1926. They purchased it then. (R. 2837.)

Generally there was no difference in the river bed down at Lockhart Canyon than he has described further up the river. There are certain stretches of the river, both up and down that are always more or less troublesome, that is, they offer delays, The Lockhart district is not any more troublesome than any of the upper portion with which he is familiar. (R. 2837.) This trip that he made in 1927 down to Lockhart was the same trip that Mr. Yundt was on. Both of them were on the barge; didn't make the entire trip in the barge; they were repairing the little boat on the way down; when got it repaired and calked, stuck it in the water and went on ahead with the little motor. They left the big boat somewhere about the mid-point between No. 2 [oil well] and Lockhart Canyon. (R. 2837.)

Lockhart Canyon, in the vicinity around Lockhart, has probably more exposed bars, and the river channel is what they call better water down at Lockhart than in the upper portion of the river; that is, the water surface indicates the channel a little bit better, and you are able to find it with less trouble. But it does change. Wouldn't say day to day, but it changed throughout the period we were there in a good many places, whereas some places remained much the same. Encountered whirlpools, in and about Lockhart, both above and below Lockhart. (R. 2838.)

The whirlpools had little effect on the boats like they were using if they were not heavily loaded, other than to change the course of the boat. If you head them at full speed going downstream they were apt to give you quite a tilt and a possibility of throwing you out. But they never did, however. (R. 2839.)

The first supplies brought to the camp at Lockhart Canyon were carried on the barge, and subsequent supplies were brought in by truck; there were two loads, possibly three, brought in from the Indian creek camp of Mr. Moore and Mr. Yundt. (R. 2839.) He did not have a pack outfit. The other parties, that were in touch with him, in the same camp sometimes, would always have a pack train available. (R. 2939.)

When he had completed the work down there in 1927, he returned up the river the first week in December, 1927, in the black boat of the Moab Garage Company which he had arranged to be brought down to No. 1 oil well. He wanted that as an emergency boat to get out of the river after the stock had left, so that was delivered to him two or three weeks after he first made his trip down, and leaving the country he went out with the black boat and the little boat as a trailer. There were two men with him; one was the line assistant, and the cook that was down there. (R. 2840.) In making that return trip broke off a support for the propeller of the big boat, and endeavored to use the little boat, pull it over to the bank. Sheared

off propeller pins twice. That was the major trouble they had. That was occasioned by getting on the sand bars; that was the damage that was done by getting on the sand bars; sand bars were frequently hit, but that was the only time any real damage was done.

He was operating the boats himself daily and was quite familiar with the channel, because of the daily operation. (R. 2840–2841.)

He was back on the Colorado River about the 20th of October, 1928, and went down about sixty miles to the portion of the river known as the loop about six miles above the junction. He had two small sixteen foot boats each equipped with an out-board motor.

He was accompanied by the cook, a man named Gray. The rest of the party had arranged to come overland by truck and pack. They were located at the foot of one of the only trails coming in to the lower portion of the river. (R. 2841.)

This trail comes in near the south east corner of Township 29 South, Range 19 East, and was made by one of the oil companies four or five years ago. They endeavored to make a road but found it impractical, and it developed into a fairly good pack trail portions of it very rough, but can be used. (R. 2842.) This trail joins on the road that comes down Indian Creek.

His work this year was of the same general nature as it had been in previous years with the

additional duties of carrying lines on the high mesas. (R. 2842.)

During his work down there one of the other boats taken down was used all the time and outside of a few items that he took down on his first trip the camp was supplied entirely by truck and pack train from Indian Creek and he believes the supplies were purchased at Moab or possibly Monticello.

He was almost daily on the river in the little boat during the progress of the meander work.

The operation of his boat on the lower portions of the river was different from the fact that he encountered more submerged rocks. The upper portion of the river where we would have delays would be occasioned usually by the bars. The lower portion of the river quite frequently would hit a submerged rock. (R. 2843.)

On the type of boats he was using the propeller is attached to the drive shaft with a small pin known as a shear pin and when the propeller hits a rock the pin will give to prevent damage to the gears of the motor and it is necessary to install a new pin. (R. 2844.)

When completed work down there in 1928 party went out with these two boats, four of them made the trip up the river, about the 15th of December. It was just after the ice cakes had started coming down the river. Had difficulties on the way up with the operation of these boats; both in motor

difficulties and boat troubles. Boat troubles, in trying to avoid ice cakes, which were two or three, perhaps four inches thick, in places and the motors would freeze up. The water at that time was just filled with a sort of slush ice; the propeller wouldn't force the water up as a cooling medium; frequently stop and clean out the motor. The sand bars they didn't offer any more trouble then than they had in the past; always figure on delays on them but no damage was done. (R. 2844–2845.)

The pack outfit returned over to one of the mesa parties. Vol. 15, R. 2845.

Cross-examination (R. Vol. 16, pp. 2848–2853):

With the inboard motor boat he operated there is a metal projection that fends off obstructions from the propeller and this would strike before the propeller struck. (R. 2848.)

On the outboard motor there is a tilting propeller, which did not have any skag to protect it.

The black boat he first used was an inboard motor boat but he did practically most of his work with the outboard motor boats.

He believes that he has made probably not over three complete trips and half dozen or less fractional trips on the large barge of the Moab Garage Company. (R. 2849.)

He believes he made two trips from Lockhart up, at least one from No. 2 well to Moab and at least one from No. 1 camp to Moab and these were all of the trips he recalls having made.

While he has never seen it, he knows that the government parties had a camp on Indian Creek back from the rim of the canyon a number of miles. (R. 2850.)

There was a road over which trucks and automobiles traveled to a little beyond Indian Creek and the camp on Indian Creek may have been a sort of distribution point for the other camps during 1927. His Lockhart Camp was approximately twenty miles from the Indian Creek Camp and about eight miles by pack string, from the other camp to the end of the road. (R. 2851.)

He can't say that when he was camped at No. 1 and also at No. 2 that he was not advised when the Moab Garage boats were going to leave Moab and during this time he got practically all of his supplies by boat.

When he was at Lockhart it was not necessary for him to make special arrangements for a special trip as he did get one or two small assignments of supplies from No. 2 by taking supplies from the big barge at No. 2 camp and taking them to his camp at Lockhart with the little boat.

If the Moab Garage boat had been employed to bring the supplies down after his initial trip it would have been necessary for him to have made special arrangements for them to make a special trip.

The distance from Moab to Lockhart by the river he called forty miles. (R. 2851–2852.)

When he was camped at Lockhart he obtained some supplies from Indian Creek and from the other camp that was about eight miles away. (R. 2853.)

Redirect examination (R. Vol. 16, p. 2853):

He can not give the approximate location of the road between Moab and Lockhart Canyon as he has never been over it except the portion near the river. (R. 2853.)

Further examination (R. Vol. 16, pp. 2853–2854):

He was in charge of the party that made the measurements along the river. One can not walk down the banks of the river all the way from Moab to Lockhart; it is impossible in a good many places. For expediency of the survey it is necessary to have boats, because of the sheer walls that prevent a person walking along the river, and the very dense undergrowth; also crossing that river from side to side. (R. 2853–2854.)

LOREN L. TAYLOR

For Complainant

(Vol. 16, pp. 2854–2894)

He resides at Moab, Utah, where he has lived all of his life. He is 38 years old and publisher of Times Independent. Place of business about two miles from mouth of Mill Creek. He has never been farther down the Colorado River than No. 1 well.

As a boy he went swimming many times, and has been in rowboats, but never in a motorboat. (R. 2855–2856.)

Understands there are between 1,800 and 2,000 acres under cultivation in Moab Valley. Water for irrigation is obtained from Mill Creek and Pack Creek. (R. 2857.) Some periods of the year there is very little water running. (R. 2857.)

He has waded across Colorado River as a boy, and has seen cattle driven across, but has not seen them swim. (R. 2858.)

Certain copies from files of news items of Grand Valley Times, now Times Independent, newspaper owned by Mr. Taylor. Compl. Exh. 460. Vol. 16, p. 2887.

He has been on Colorado River from time to time since a small boy. His grandfather started the first ferryboat on river at Moab. (R. 2855–2856.)

Channel at Moab changes occasionally; where Court House creek and Mill creek come in, they bring great bars of sand and driftwood, and almost put a dam across the river at times, when river will cut through at different places. (R. 2856–2857.)

The volume of water varies; sometimes it is deep and sometimes it is not so deep, especially during the fall of the year, midsummer, and winter. (R. 2858.)

He made his first trip on the Moab Garage barge in April, 1924, with rising water and a good volume; they did not encounter sand bars. (R. 2860.) Made a trip down to the No. 1 well. Instead of riding back on the boat, he walked back. (R. 2859.) On the next trip going down they were heavily loaded and got on a bar. They went back and forth and churned the wheel, but did not get off. While they were eating dinner, the sand shifted under the boat and the action of the wheel caused it to shift and boat floated off. (R. 2860–2861.)

As far back as he can remember does not know of Colorado River being used for the purpose of bringing merchandise and supplies to the City of Moab; and he does not know of any agricultural products in and about Moab being shipped out on the Colorado River. (R. 2863.)

Cross-examination (R. Vol. 16, pp. 2865–2881):

He will be thirty-eight years old in a month or two and that he saw lumber rafted down the [Colorado] River from a point about twenty miles above Moab. (R. 2865.) This would be from a point several miles above the mouth of Castle Creek. (R. 2866.)

There was one saw mill, operated by T. W. Branson and Sons on the Lasal Mountains, and when he was a boy there were several years that they rafted sawed lumber down. This was at least twenty-five

years ago. (R. 2868.) He can't describe these rafts, as his only recollection is seeing them float the lumber down. They seemed large to him, but he would say that they might have been forty or fifty feet long, approximately half as wide, and he believes the cargo of lumber would extend quite a little distance above the top of the raft. He does not believe that they contained a lot of lumber; he believes there were several thousand feet. (R. 2869.) There were usually two or three men on the raft with poles. (R. 2870.)

In his direct examination he did not imply that supplies of various kinds had not come down the river from Moab to the oil wells and Lockhart. He knows that equipment of various kinds, including machinery and other freight of that character, came up the river to Moab. He recalls that people went down the Colorado River to Moab, prior to when the Moab Garage Company started to operate, and he believes they would resupply themselves and continue on their journey, but he does not remember. (R. 2870–2871.)

He does not know how many trips the *Undine* made from Greenriver to Moab. He does recall the *Undine* coming into Moab from some point below on the river, but does not recall three separate occasions. He does remember several times the boat came, "it was quite an event." (R. 2872.)

He could not tell how many passengers were on the *Undine* on its first arrival at Moab. He recalls several men, but could not say whether there were

one, or three, or half a dozen, or many, and has no definite remembrance of the number of passengers on the second or later trips.

After the *Undine* was wrecked he went up to see it and it was located possibly two or three miles above Nigger Bill Canyon. (R. 2873.) The hull of the boat was up-side-down on a rock in the middle of the stream, and there were two men on it when he saw it. The river is rather narrow there and it is rather a swift rapid. He does not know whether or not it is the swiftest portion of the stream between Moab and Castle Creek. (R. 2874.) They sent word of the wreck down to Moab. His father had a ranch right close to the lower part of town. And a man working for my father took a wagon, or the running gears of a wagon, and put a row boat on it, and went up the river to get those two men off. He went with him.

He didn't have any power boat at that time. (R. 2874–2875.)

He kept in rather close touch with the operations, while the oil wells were being drilled, and in a general way was trying to keep in touch with the operation of the boats. He believes the trips were made with reasonable regularity. He knows they had lots of delays, but they hauled a lot of freight. (R. 2875–2876.) As to whether or not they were running on schedule or anything like that he doesn't know. (R. 2876.)

He has seen one of Mr. Wimmer's boats at Green-river once, but does not ever recall of seeing him

at Moab, although he knows he came in with a boat a time or two. (R. 2876.)

He has also heard of Mr. Wolverton in connection with operating on the river.

It is his understanding there are eighteen hundred to two thousand acres of land under cultivation in Moab Valley, and he imagines there are eight to ten thousand acres susceptible of irrigation. He is familiar with other country in southeastern Utah. (R. 2877.) He believes there is more acreage under cultivation at Greenriver, Utah, than there is at Moab, and would judge there were many thousands of acres in the yicinity of Moab that are susceptible of irrigation and cultivation. In the section south and east of Greenriver and Moab there are many thousands of acres of fertile land that could be farmed, if they could get water on them. (R. 2877–2879.)

He does not know anything about the mineral resources in the Lasal and Blue Mountains. This section of the country has quite a livestock industry, both sheep and cattle, and be believes that at the present time it is a vast undeveloped empire, with tremendous potentialities. (R. 2879.)

There has been many placer operations along the Colorado River, both above and below Moab; it has been more prospecting than anything else. Then in the Lasal mountains there has been prospecting and mining operations under way there for forty or fifty years. (R. 2879–2880.) He knows that the big Indian copper properties are located twen-

ty-five miles out of Moab, that the copper occurs in sandstone, and that mining men and prospectors tell him that there are a great many showings of mineral wealth. (R. 2880.)

He is not familiar with the coal fields of Kane County in the vicinity of the Colorado River. He knows that there is some coal shipped to Monticello that goes through Moab from Sego. Sego is a coal camp five miles north of Thompson in Grand County. There are some little coal deposits of poor grade east of Monticello, east of the Blue Mountains. He knows of no coal in the Lasal Mountains. (R. 2880–2881.)

Redirect examination (R. Vol. 16, pp. 2882–2890):

He has seen two or three or four lumber rafts on the Colorado River, four at the outside, and that the words "general use of the river for lumber rafts," is limited to the four times that he saw them. (R. 2882.)

When he went up to view the wreck of the *Undine,* the boat was taken up on a wagon, because it was lots quicker to get there by wagon. He does not know whether this vast empire that Mr. Farnsworth referred to in eastern Utah can be irrigated from the Colorado River, nor does he recall the periods of the year when the lumber rafts came down. (R. 2882.)

Certain copies from the files of news items of the Grand Valley Times, now the Times Independent, newspaper, owned by Mr. Taylor, were received in evidence as Compl. Exh. 460. (R. 2883.)

He testified that mail has been brought to Moab since 1915 by truck and bus, and prior to that time, as long as he has been familiar with the conditions, by wagon from Thompson, Utah; that Thompson is generally the shipping point for Moab and is from one to two hours by automobile truck from Moab. (R. 2887–2888.)

He identifies Exhibit No. 121, as a picture of the boat, *Undine,* which was propelled by a stern wheel. (R. 2888.)

Recross-examination (R. Vol. 16, pp. 2889–2890):

He did not say that he had a definite recollection of seeing rafts of lumber come down the Colorado River four times. He did say just a few times, as he can't remember, but he does not believe it was over four times.

Moab got its supply of lumber during the years that he saw the rafts, from the north end of the Lasal Mountains, from the Branson country. (R. 2889.) He believes that some of the lumber was hauled in as well as coming down the river, but he does not recall how many times he has seen lumber hauled over land. His recollection to that is the same as his recollection in reference to the rafts. In giving his answer as to the general use, he had in mind the matter of common knowledge, in respect to rafting of the lumber. (R. 2890.)

Further examination (R. Vol. 16, pp. 2891–2893):

He has been along the road over San Juan county as far south as Bluff; east to the Colorado state line in San Juan county, and in Grand county he believes he has been in every section that is accessible. He has never been but two or three miles west of Bluff, and his statements regarding the possibilities of those portions of the state would be confined to the territory east of Moab, Bluff, and Monticello. (R. 2891.) Moab Valley is located where Spanish Valley is named on the pleading map. (R. 2891–2892.)

Court House Wash and Mill creek discharge large quantities of water and sand in below Moab landing occasionally. (R. 2892.) Court House Wash flows into the [Colorado] River about one hundred yards below the Moab Garage boat landing. (R. 2892.)

He knows nothing personally as to the irrigibility of the land in San Juan county adjoining the Colorado or the Green Rivers. (R. 2893.)

Redirect examination (R. Vol. 16, pp. 2893–2894):

In the vast empire he has testified to, he has seen hundreds of miles of it; he has been east of Bluff to the Colorado state line on the wagon road and has hunted in that country, and possibly some of the information he has was obtained on the hunting trips. (R. 2893–2894.)

Moab Valley has now a population of about twelve hundred people. (R. 2894.)

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No. 14, Original

In the Supreme Court of the United States

OCTOBER TERM, 1930

No. 14, Original

THE UNITED STATES OF AMERICA, PLAINTIFF

v.

THE STATE OF UTAH, DEFENDANT

ABSTRACT IN NARRATIVE FORM OF THE TESTIMONY TAKEN BEFORE THE SPECIAL MASTER, AND FILED IN THIS COURT BY HIM

IN TWO VOLUMES

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VOLUME 2

(Pages 749 to 1426)

JOHN B. CLEARY

For Complainant

(Record, vol. 16, pp. 2894–2959, 2979–2983)

He resides at Casper, Wyoming, is a civil engineer and has been employed by the Midwest Refining Company for the past eleven years; two years prior to that with the Standard Oil, who now own the Midwest. (R. 2894–2895.)

The Midwest Refining Company in its operations on the Colorado River between Moab and Lockhart Canyon, spent approximately two million dollars over a period of two and a half years.

The Midwest Refining Company is not interested in bringing in any more wells down there. (R. 2895–2896.)

He first went in and about the Colorado River December 31st, 1925. It has been his duties with the Midwest over the past eight or nine years to visit any well that gave promise of being a producer or bringing in a producing field, and from that visit to make a report of transportation facilities, water supplies, construction of camps and appurtenant structures necessary in a producing field. He went to what we termed at that time No. 1, the Shafer well, with that in mind, as well as to check the location of the well and the staking of the permits on which the well was located. (R. 2896.) The permits referred to were those obtained from the United States Government and were known as oil and gas permits of the John Shafer property and the Frank Shafer property. (R. 2896.) His company received information that the well had made a flow of oil on December 8th. (R. 2896-2898.)

He went down to Shafer No. 1 from Moab on the Moab Garage barge. Virgil Baldwin was in charge of the boat; and with him were Mr. Edwards and a transit man by the name of Ricker. (R. 2898.) Left Moab shortly after noon on December 31st, and proceeded down the river; about half way to the location we grounded on a sandbar and spent almost two hours releasing the boat. Released it by taking a line to the shore and putting pressure on that line with a winch they had on the boat, pulling the boat from the sandbar; after repeated trials, they again were able to proceed. Proceeded down the river to a point about a mile above the location, at which time darkness over-

took us. The boat was tied up, and walked from there to the location, arriving approximately about eight o'clock. (R. 2898–2899.) He remained at Shafer No. 1 about seventeen days, during which time he investigated the permits' staking,. the actual setting of monuments that had preceded the drilling; as well as transportation routes and a pipe-line route; in other words, a road to the pipe line out of the Shafer well. (R. 2899.) The investigation of a pipe line was made because it was thought they might have a field there, it would be necessary to transport the oil by way of a pipe line out of that territory.. (R. 2899.)

He made an investigation of a roadway for the purpose of transporting material into a producing oil field. (R. 2902.)

At the time he went into this question of the road he had knowledge that the river had been used for the purpose of bringing down casing tools and other supplies for this oil well. His company had transported material by way of the river. (R. 2903.)

Since he has been in the oil business he has had experience in transportation of equipment into each and every oil field the company has drilled. (R. 2906.) It has been one of his problems while with Midwest Company to determine what type of transportation goes into that field, and how it shall go in, the construction of storage material, yards for the storage of material, and arrangements for transportation—facilities for its transportation. During the eleven years with the Midwest Refining

Company, nine of them have been spent particularly on that subject. (R. 2906.)

The necessary elements that he takes into consideration in the development of an oil field with reference to transportation, are the feasibility and "the cost and the type of equipment that goes in there, and the time in which it should go in. In other words, the amount of tonnage that has to be put in over a given period. (R. 2907.) In the development of an oil field it is absolutely necessary at times to get the freight in there promptly.

In the supplies which were shipped down by boat from Moab, difficulties encountered were in the length of time, and in the amount of freight that can be hauled on a boat that can travel on the Colorado river between those two points. The fact that the freight had to be unloaded at Thompson and unloaded again at the Moab dock and re-loaded on the boat, figure in the problem. (R. 2907.) A system of transportation which requires two loadings and two unloadings has a bearing on the case in the transportation or unloading of your field equipment; your unloading has some bearing on breakage of equipment.

He has been on Colorado River many times. (R. 2909.)

Transportation into new oil fields require the transporting of somewhere between fifteen million and forty-two million pounds of freight per year, from his experience in oil fields. That gives a leeway enough to answer the purpose in any Rocky Mountain oil field. (R. 2910.) Very seldom a

field with less than three wells is a commercial productive oil field, in order to handle that amount of tonnage. (R. 2910.) The capacity of the Moab Garage [barge] was fifteen tons.

Basing his answer upon his experience in transportation and as an engineer, in his opinion the boat of the Moab Garage was not of sufficient capacity to supply a producing oil field in and about Shafer No. 1. To supply a producing field would require about 8 or 10, maybe 20, boats of that capacity. (R. 2911.)

When he speaks of supplying a producing oil field he means to bring in the necessary equipment and supplies over a period of approximately five years. (R. 2912.) They were using all derricks down there [on the Colorado River].

The complete rig for an oil well with a depth of forty-five hundred feet, weighs in round figures a million pounds. The heaviest piece of machinery or equipment would weigh approximately twelve thousand pounds, and that would be a boiler. Such a piece of equipment was brought down to these wells in a boat, it was over all, twenty-two feet long. (R. 2912.) The weight of the derrick in its total is approximately two hundred thousand pounds. Those were brought down piece-meal. The equipment necessary to have brought in from time to time to a producing oil field consists of, "Tankage"; in the first place, camp equipment; a camp generally is expanded after a producing

oil field is found, and casing—later on, as the field declines, tubing, rods, and pumping equipment, so that the continuation of material into a field is almost continuous up to the point of its decline. (R. 2913.)

The supply of material that is continuous consists of pumping material; various methods of pumping those wells that decline; the field generally flows at the beginning and then is pumped after it declines. After the pump is in, it would not be necessary to supply any pumps, but they are then supplied with new pumping equipment, rods, tubing and casing, that has to be replaced. The heavy equipment comes in first. (R. 2913.) That is not a continuous supply, but in a way it is; very small difference in the weights of those component parts; if a pump failed, there is pumping engines. (R. 2913–2914.)

Compl. Exh. No. 461, the drawing of a reconnaissance, made by him for a pipe line (R. 2914), received in evidence (R. 2915–2916).

On the first trip that he made down (to the wells) he made a reconnaissance for a pipe line. Compl. Exh. No. 461 is the reconnaissance which was prepared, at the Shafer camp, between the 1st and 17th of January (1926). (R. 2896.)

The pipe line proceeded from Shafer No. 1 up the river to a point about six miles above Shafer No. 1. The pipe line was on the edge of the river. The river at that point is rather board; and from that point through a canyon, called Knob Canyon. (R. 2914.) That canyon is at approximately mile

post 54. From Knob Canyon the pipe line went through the canyon to the point of the Thompson-Moab road. (R. 2914–2915.)

He made that reconnaissance by walking over part of that line; went into both ends of the canyon far enough to satisfy himself of the nature of the canyon and of the river; walked over part of the line and again viewed it from a boat as he went up and down the river. On the Thompson-Moab end he drove in a car. Saw practically all of it. (R. 2915.)

On his first trip down there he remained about seventeen days at the location, and during the time of his arrival and the 17th day of January, when he left, and in addition to his work on the pipe line reconnaissance, tracings were made of the boundaries of the Frank Shafer and John L. Shafer permit, as well as located additional wells on each permit, and made the location for what they afterwards termed their No. 2 well, or the John H. Shafer permit well. (R. 2916.) He actually participated in running practically all of the lines of those permits. After that work was done Mr. Edwards finished up the work on those permits; but there were some lines yet to be run when he left. (R. 2916.)

He made no other trips back to Moab, except at the time he came out January 17th. He was on the river up and down in the structure practically all that time or at least every few days, but he didn't travel clear back to Moab until he came out

on the 17th. (R. 2916–2917.) He only used the boat for part of the way.

From Shafer No. 1—or No. 2, which is approximately mile post 37, he used the boat that has been termed the black boat, the passenger boat for the Moab Garage Company, up to No. 1. A day or two later he came from No. 1 to a point about Island Mesa, a mile and a half above No. 1 well, and walked from there to Moab. That was when he was coming out.

On account of the slowness of their motor transportation, and on account of the trail ending at Island Mesa, they were in such a state of mind when they got there, they walked from there on in to Moab. (R. 2917.) They had their own boat at that time called the *Riff Climber*, made by the Grey Motor Company. The boat was seventeen feet in length and four or four and a half feet wide. (R. 2917.) It had a Grey motor and a tunnel propeller. The boat was cut out underneath; it was a flat bottom boat with the propeller running in the tunnel, designed especially for this particular job by the Grey Motor Company. (R. 2918.) By that he means that they submitted to the Grey Motor Company the conditions that existed on the river and asked them to submit them a design for a boat that would answer certain requirements as to speed and navigability of the boat. (R. 2919.) The condition of the river includes velocity. (R. 2920.) He was present when this was done, and assisted in the specifications. (R. 2920.)

When he reached Island Mesa it was a very good day and very good weather in January. The temperature on the edge of the river as they walked was quite warm; it was cold on the river during those days. (R. 2920.) It took nearly an hour to go from Shafer No. 1 to Island Mesa.

The next time he returned to the Colorado River was the evening of February 25th, 1926. The purpose of his return was to make the road survey into the well.

He came overland through Moab. (R. 2920.) He went back out to the mouth of the canyon and made a survey through the canyon and then returned to Moab. (R. 2920–2921.) He went by automobile to the end of the canyon, to the upper end of Knob canyon. He made a survey through the canyon and returned to Moab by boat. The passenger boat of the Moab Garage Company that met him there is known as the black boat. He was then for four days back and forth on the river, on the lower end of the survey around Knob canyon, and was using at times the black passenger boat of the Moab Garage Company. (R. 2921.) On one of those days he made a trip completely to (Shafer) No. 1 from Moab. (R. 2921.)

After he had finished the work around Knob Canyon they started the construction of the well, or the construction of the road at Elk ridge, south of Moab, and away from the river, and then returned to Casper. (R. 2922.) On that trip he

completed two reconnaissance surveys for the road. (R. 2922.)

He identifies Compl. Exh. No. 462, as a map on which is platted the actual road survey and the reconnaissance as made of the road from the Thompson-Moab road to the Shafer No. 1 well. (R. 2922.)

He identifies Compl. Exh. No. 463, as a map of the reconnaissance made from Knob Canyon to the Shafer well superimposed on the Government survey of the river, the Government profile survey bulletin 465. (R. 2922.) The road from Shafer No. 1 went up along the river on the bank of the river to Knob Canyon. The road went to a point below Shafer No. 1, which was to have been the storage yard. (R. 2923.) The red mark on the map is the road. That road survey shown on those exhibits is a road that runs through a character of country where it is perfectly practicable to build a road at a cost. (R. 2923–2924.)

He identifies Compl.'s Exh. Nos. 464, 464A, and 464B, as a map of a preliminary survey and projected location of a road through Knob canyon from a point on the Thompson-Moab road to the Colorado River. This is the same road as the other one, but it brings out the survey in their standard form for survey shots. (R. 2924.)

He was not on the barge after the first time. (R. 2925. He returned there about the last of March or the first of April; and he was in the country then

at almost regular intervals until the first of September; not continuous, however, because they were doing work on south, and work in Wyoming, which was under his supervision. (R. 2925.)

He has been on the Colorado River frequently in boats. In his experience on the Colorado River, they were stuck with the small boat, and with the passenger boat, at different times; at other times they made the passage quite freely. (R. 2925–2926.)

Every trip he found that there were changes and shifting in the channel. By that he means on one trip down they would find a way to get around, and within just a few hours they were not able to make the same channel. That occurred to them different times. (R. 2926.) It occurred at different places. In some instances they found the channel in the same position. The last time he was on the Colorado River, he believes, was the twenty-sixth of August, 1926. (R. 2926.) He has not been back since. At the time he was there from March until September they had high water during that summer, quite high in June; some in July and again in August they had rather high stages. (R. 2927.)

He has been on the San Juan River in New Mexico but not so much in Utah. He has been above Bluff on different occasions. His work has been in New Mexico on the San Juan. He has been around Bluff enough so that he can give an idea

of the San Juan River at that point. He was around Bluff during the summer of 1926, and prior to that in 1921. He was not west of Bluff at all. He was north of Bluff practically; that river flows east and west; it would be east of Bluff and north and a little west. (R. 2927–2928.)

As he recalls the San Juan probably had a discharge of four thousand [second] feet at the various times he saw it; it was quite wide for the discharge. He does not know how wide it is there at Bluff. His company has a producing field at Shiprock, New Mexico, ten miles from the San Juan River. A truck is used to transport the freight in to Shiprock. They drilled eight wells up there. The freight which came in on the railroad to Farmington, New Mexico, was hauled from that railroad point (to the oil field). (R. 2928.)

The *Riff Climber* was gone when he went back. (R. 2928–2929.)

Cross-examination (R. Vol. 16, pp. 2929–2955):

The (road) survey was commenced by him March 3, 1926, and he personally had the survey in charge every day from the start to the finish. (R. 2929.) The survey was made in order that an estimate might be prepared on the cost of construction of the road, in the event an oil field was developed. That was the sole purpose of the survey. (R. 2930.)

Complainant's Exhibits Nos. 464, 464A, and 464B, identified by witness as representing the same sur-

vey as indicated on Complainant's Exhibits Nos. 462 and 463, with the exception of the blue print, Complainant's Exhibit No. 461, which was a survey made before the road survey, and is a reconnaissance survey.

Compl. Exh. Nos. 464, 464A, and 464B are maps of the same survey exemplified by Complainant's Exhibit No. 462.

Compl. Exh. No. 463 is a reconnaissance survey commencing where the road survey left off, and is a continuation of the same wagon road along the river, and was made for the same purpose as the survey depicted on Complainant's Exhibits Nos. 464, 464A, and 464B.

"Cleary's P. line," appearing in parentheses on Compl. Exh. Nos. 464, 464A, and 464B, represents a preliminary survey, the letter "P" being used to designate preliminary lines. (R. 2931–2932.) The preliminary survey, as indicated on the Exhibits mentioned, located the actual route of the road except for minor changes to conform with proper curvatures and grade. (R. 2932.)

The route of the pipe line was approximately parallel to the (survey) line, shown on Complainant's Exhibits Nos. 464, 464A, and 464B. (R. 2933–2934.)

Its location was not identical with the road line shown in his map, as a pipe line can be constructed over country that a road can not. The Exhibit does not represent the original pipe-line survey,

because he did not make the pipe-line survey; he made a reconnaissance survey. (R. 2934.) He did not state that the pipe line survey was substantially identical with the reconnaissance survey but meant it would be in about the same country. (R. 2935.)

The red marks on Complainant's Exhibit No. 462 were put on for the purpose of estimating the cost of the road, and the estimate was made from data collected by him in February and March, 1926. (R. 2936-2937.) Cleary P. Line doesn't mean Cleary pipe line. Absolutely not. (R. 2938-2939.)

The sketch of the pipe line on Compl's Exh. No. 462 was made before the survey made by him, in order to avoid a filing in the Land Office. There was no actual pipe-line survey ever made so far as he knows. (R. 2939.) In referring to sketch for the pipe line, he refers to Complainant's Exhibit No. 461, termed reconnaissance for pipe line, and it was thought to be quite important to determine as to whether it was practicable to get a pipe line out of the country. Heavy material had been taken down [the river] for the purpose of drilling the initial well only. (R. 2940.) The initial well of discovery well is known as No. 1 [John H. Shafer No. 1 well].

At that time there was sufficient indications to warrant making a test for oil, and enough assurance for speculation, as to the tonnage necessary for a producing field. Computations were made as to how many boats would be needed to take care of the situation, for the purpose of a comparison with other methods of transportation. (R. 2941.)

He made an actual reconnaissance pipe line instrumental survey on the ground in January, but not a preliminary pipe-line survey. There was, however, a preliminary survey made for the road. (R. 2942-2944.)

He does not know whether or not the Midwest Company was one of the defendants in a suit brought by the State of Utah, but the Midwest Company is no longer interested in the field, having relinquished its interests and stored its equipment. The interests that were sold or otherwise relinquished by the Midwest Company were obtained in the first place through the Utah Oil Refining Company and the Midwest Exploration Company, and when he said they were no longer interested there, he meant they had parted with such interest as they did have. (R. 2945-2947.)

He arrived at that oil field December 31st, 1925, and immediately afterwards made a reconnaissance survey for a pipe line and for a road. At that time they had struck oil in the discovery well [John H. Shafer No. 1] at a depth of two thousand twenty-eight feet. He was not on the ground when they started to drill, and all of the heavy equipment had already been placed on the ground when he arrived there. (R. 2948.)

When the company for which he worked begins drilling operations, it is the general practice to make a reconnaissance survey before going to the expense of getting their equipment and supplies on the ground. (R. 2948-2949.) It is their practice

to put the material on the ground, not necessarily to make a reconnaissance.

When a structure is brought to the company for drilling, an estimate is prepared of the cost of that well. It is put before the executive committee for approval or disapproval. The estimate itself is based sometimes on my estimate sitting in Casper and knowing about the country down here. Quite often it is on the road, if that is logical—if it is a recommended structure and our cost isn't excessive, they quite often drill a well without due regard to pipe-line facilities or road facilities. They know if they get oil, it will be there when they go to get it; that their pipe line hasn't been brought out. He knows what type of country it is, and how they can build a pipe line; its cost, and the size of the well, they determine after the well is in, how much they will spend for it. (R. 2950–2951.)

His estimate as to the construction of the twelve and three-tenths miles of road was one hundred and twenty thousand dollars, but construction was never commenced. (R. 2952.)

His company constructed a road to Elk Ridge for the purpose of getting material and equipment in. The road was constructed from the junction of the Kaygalia-Blanding road. On the occasion when he walked from Island Mesa to Moab, because of the slowness of the boat, he had no motor trouble and the engine was working alright. When he

ordered the boat (*Riff Climber*) he had no information concerning the tunnel boat used on the lower stretch of the Colorado. (R. 2953.)

He did not make an estimate of the cost of upkeep of the road. A boat like the large Moab Garage boat would cost about one and one-half times as much as a fifteen-ton truck. (R. 2954.)

Construction of the road was not contemplated unless a producing oil field was developed and until that time it was decided that transportation on the river was feasible and practicable. (R. 2955.)

Further examination (R. Vol. 16, pp. 2956–2959.)

When he testified that a large boat like the Moab Garage boat would cost one and a half or two times as much as a fifteen-ton truck, he had in mind the cost of the boat as being twelve thousand dollars. If the boat cost seven thousand dollars, it would be about the same as the cost of a truck of that type.

There were actually 238 barrels of oil produced on the twenty-four hour run in the middle of January, from the discovery well [John H. Shafer well No. 1.] The first flow, of not to exceed 200 barrels was wasted. The third twenty-four hours, 80 barrels were produced and 40 barrels per day for something over a month afterwards, together with about 400 barrels of water. (R. 2956.)

As he remembers, the wells stopped producing in November or December, 1926. The well was not

producing commercial oil when the company rights were relinquished. There are no producing wells on Elk Ridge, the well drilled by his company being a dry one. His company has drilled thirteen or fourteen dry wells in the State of Utah, eight or ten of which are in the southeastern part; one on Elk Ridge, 4 on the [Colorado] River, one at Cedar Mesa and one at Gypsy Creek on the Arizona line. These wells were drilled after a geological examination of the structures on which they were located. The oil produced from the discovery well was used as fuel in drilling another well. None of the oil was taken up the river unless it was merely for test purposes. (R. 2958-2959.)

Recalled (R. Vol. 16, pp. 2979-2983).

Further cross-examination (R. Vol. 16, pp. 2979-2983);

Compl. Exh. No. 463 is a continuation of Compl. Exh. Nos. 464, 464A, and 464B. The survey made at the same time.

It happens that the road shown on Exhibit 463 was not depicted by similar lines to those appearing on Exhibits 464, 464A, and 464B, because one is a reconnaissance and the other is a preliminary survey. They were made at the same time. (R. 2980.)

The red line apearing on Compl. Exh. No. 462, which has under it the words written in red, "Road survey by J. B. Cleary," connects up with the line on Compl. Exh. Nos. 464, 464A, and 464B. (R.

2980-2981.) The red line shown on Compl. Exh. No. 462 is the preliminary survey.

The survey shown on 464, 464A, and 464B is delineated again on Compl. Exh. 462. The same survey, except on different paper, different map; it is a platting of the same survey. (R. 2981.)

The section shown on Compl. Exh. No. 462 is the same section as is shown on Compl. Exhs. Nos. 464, 464A, and 464B. Compl. Exh. No. 462 also shows what is termed road reconnaissance on Complainant's Exhibit No. 463. (R. 2981.)

He indicates in pencil on Compl. Exh. 462 the end of the line of the proposed road as it approaches the Colorado river on either Compl. Exhibit No. 464, 464A, or 464B. With an alternate proposal of the counterbalanced incline, or a half-tunnel section, the road would reach the river in the two different points thus [indicating], which is this junction here [indicating]. (R. 2981-2982.)

The end of the line of the proposed road as it approaches the Colorado River was shown on there before he drew with a red pencil, several inches of line on the Exhibit. (R. 2982.) The line that he drew represents alternate proposals of reaching the river. (R. 2982.)

WALTER F. EDWARDS

For Complainant

(Record, vol. 16, pp. 2959-2979)

He resides in Midwest, Wyoming; is a civil engineer for the Midwest Refining Company, and his

professional employment has taken him on portions of the Colorado River.

He reached Moab on the 31st of December, 1925. They went down from the boat landing to the John Shafer No. 1 location, and arrived there late that night. He was there until the latter part of January, about the 25th, then returned to Midwest. And on approximately the 25th of March he went back to the Shafer No. 1 location, and remained there continuously until about August 25th—about the ~~1st~~ of September. (R. 2960.)

His first trip from Moab down to the Shafer No. 1 well was made on the Moab Garage Company's big barge, stern-wheel boat. (R. 2960.). That was the same trip that Mr. Cleary made. About halfway down we had considerable trouble on one sand bar; ended up by having to ~~run~~ a line ashore and pull the boat off by the winch; they were there a couple of hours. Then darkness overtook them, and the boatman was unable to go any further; landed at a point called Grand landing, a point in the river about a mile above the Shafer No. 1 well location. (R. 2961.) From that point ~~they~~ walked down the side of the cliff to the location. As work in that section, between the 31st of December, 1925, and the 25th of January, 1926, included the running out of existing permit boundaries as established by monuments on the Frank Shafer and John Shafer permits, comprising eight sections in all on both sides of the Colorado River.

In the course of this work it was necessary for him to cross the river from time to time. (R. 2961.) They used a motor boat, the *Riff Climber,* and in one or two instances a rowboat to go short distances. (R. 2962.) They used the boat as a means of transportation, to take them to their work up and down the river. (R. 2962.) The work started on those two permits at that time was completed; that is, the retracement of the permits as defined by the existing coroners. They later did further work on that. (R. 2962.)

In the operation of the boats, while making the survey, they experienced difficulties in running on to sand bars. In going across the river from [Shafer well] No. 1 to points west, or south of the river, they had continual difficulty there; bars seem to change at that point, which was known as the San Juan landing, possibly more frequently than any other place that they encountered; sometimes it was necessary to go a mile down the river and come back up a channel on the south side of the river, because it was impossible to get through on account of a bar that had formed since they had been there on the day previous. They went on the first trip—they made one trip overland to the John H. Shafer permit, which is about eight miles down the river, and came back part way by boat when they were stranded on a sand bar, and left the boat that night and walked into camp, close to a mile. The boat came up the next day, was able to get off after

daylight. (R. 2962–2963.) He also did work above the Shafer No. 1 well to the north line of those permits; it was about three miles. He was on the river about eleven miles the trip down.

Work in connection with the pipe-line reconnaissance consisted only in looking over the part of the reconnaissance visible from the boats. He has gone over that with Mr. Cleary; over the balance of the line he didn't go. He came out on the 25th of January on the barge. (R. 2963.) During the trip upstream on January 25th, the first trip out, had some trouble at the mouth of Bull Canyon, where it was necessary to cross from one side of the river to the other, on account of a cross channel there. They had a little trouble at that point. (R. 2964.) Mr. Virgil Baldwin or a man by the name of Walker operated the boat all of the time it was there. He believes that Virgil Baldwin had charge of the boat the day that he went out.

He next returned to Shafer well No. 1 about the 25th of March [1926]. When he made that trip he does not believe that Mr. Cleary was with him, but that the latter was on the Elk Ridge working at that time. The trip was made on the barge, and he does not recall that they had any trouble. The stage of water was some higher; the water was extremely low during January [1926]. (R. 2964.) He remained down there until about the 25th of August or the 1st of September, 1926, and during that time he was engaged in completing the survey of the Government permits on the Kane Creek

structures and the John H. Shafer structure, and running a meander line of the river through those two structures. (R. 2965.)

He identifies Compl. Exhs. Nos. 465 and 466, which are plats showing the work that they did on the river, including the land net that they ran covering the various permits on the two structures and the triangulation that they ran down the river to determine the mean high-water mark. One sheet is a continuation of the other. (R. 2966.) On those plats are indicated what they judged to be the mean high-water mark as shown by water lines on the banks of the river on either side. (R. 2966.) The mean high-water mark was determined usually by the character of the sand banks on the edge, showing the average point at which the water receded on each side. (R. 2966–2967.) That is the point that is represented by this continuous heavy blue line on the map. There is vegetation along there in the form of willows and grass that was growing. That was taken into consideration in determining the watermark. (R. 2967.)

Compl. Exh. No. 465, is a sketch showing the land net covering the permits on the Kane Creek structure and also the meander lines run down the river to determine the mean high-water marks. (R. 2967.)

A comparisor of his map and the Government meandering of the stream at that point by, superimposing one map on the other shows very little

variation in the two. He is unable to state whether there is any variation between the two at well No. 1 or whether the two wells drilled at that section, and shown on his map as being above the mean high-water mark, are shown on the Government map as being below mean high-water mark. (R. 2968-2969.) This map shows Frank Shafer No. 1 above the mean high water mark. That is also true of well No. 2. No. 1 well is above; approximately sixty feet laterally. There is no contour here, so he is unable to judge from the map how much above in elevation it is above the mean high-water mark. (R. 2969.)

Compl. Exh. No. 466 is a continuation of sheet Compl. Exh. 465 showing the land lines and meander lines on the river through the John H. Shafer structure.

During the time he was in that country he was on the river practically every day. (R. 2971.) He had trouble with sand bars, possibly not all the time, but nearly every trip, especially in crossing the river and on trips to Moab with the larger boats. He would not find the channel of the river in the same place at all times, on that portion of the river on which he operated. (R. 2972.)

While he was there he observed the effect at different stages of the water upon the sand bars in the channel. At extreme low water the channels were easier to see, because the bars would be more or less exposed. At extreme high water the bars—the greatest trouble the bars gave them was in cross-

ing from one side of the river to the other, to follow what they knew was the best channel. (R. 2972.) In traveling up and down the river as many times as they did, they of course got to know places where the water was the deeper, and at extreme high water there was enough back eddies along the banks to aid considerably in going upstream rather than trying out in the main channel. But occasionally, in going up on one side of the bank, they would run into where they knew there were submerged rocks, because at low water they would have been exposed; their only chance then was to cross the river and try another channel on the other side. In doing that, they had trouble with sand bars in the middle of the stream.

At low water those channels and banks were not covered; the water rose about ten feet while they were there. (R. 2973.)

He is unable to state whether in going up stream in high water he would have trouble if he follows the same course used in low water, because he never did that. In high water the eddies were of assistance in going up stream; the eddies were not very long, but each would assist a little in going up. When he got to the end of the eddy he generally would not have trouble getting back into the deeper water.

The *Riff Climber* was used occasionally when desirable; most of the work was done in a rowboat with an outboard motor, owned by the Moab Garage. (R. 2974.)

He didn't see the final wreck of the *Riff Climber;* hunted for it in the place it went down, the next day; that's all he knows. (R. 2974.) He hunted for the *Riff Climber* at a point approximately a mile and a half up stream from the J. H. Shafer well, a point known locally as the Eddy.

He had nothing to do with the survey of the road, but has been over a portion of the route selected for the road with a man by the name of Hank Snyder; the portion from the junction of the road to Moab, the Moab-Thompson road, and part way down Knob canyon; then at the other end of Knob canyon where it empties into the Colorado river, he has been over about practically half or three-quarters of a mile, at least until it was up from the river, up to the top of the first mesa. (R. 2975.) The road ran down the river bank from the foot of Knob Canyon to the No. 1 location [J. H. Shafer No. 1], a distance of approximately seven miles. (R. 2975.) There was a trail or wagon road from Shafer well No. 1 to Shafer well No. 2 and from a point across the river from Shafer well No. 1 to Moab. (R. 2976.)

He has been down as far as Lockhart Canyon, following cattle trails down to a point opposite Lockhart Canyon on the other side of the river.

As far as he knows the letter "P" is used universally in engineering practice to designate a preliminary survey on a map. He has done railroad

engineering and the letter is used to designate a preliminary line in such work. (R. 2977.)

Cross-examination (R. Vol. 16, pp. 2977–2979):

The statement "Drawn by H. A. W." on Compl. Exhs. Nos. 464, 464A, and 464B, indicate that the maps were drawn by H. A. Weiss, draftsman, in the employ of the Midwest office at Casper. (R. 2977–2978.)

JOHN L. DUGAN

For Complainant

(Record, vol. 16, pp. 2984–3005)

He resides at Moab, Utah; is superintendent of the Utah Southern Oil Company, and has been such for the past eight years. At the present time he is doing some work for the same company in southeastern Utah and other parts. (R. 2984.)

He has been on the Colorado River near Moab, his first trip being made in December, 1924. This trip was made from the mouth of Mill Creek down the river to what is known as the Kane Creek structure, the site of the Frank Shafer well, and was made in an outboard motor boat propelled with an Evinrude motor.

The boat was operated by Fred Strong, residing at the present time in Moab, Utah. Besides Mr. Strong, Mr. Hanson, president of the Utah Southern Oil Company, accompanied him on the trip. (R. 2985.)

The purpose of the trip was as to whether that company would participate in the operating of the Kane Creek structure. (R. 2985.)

The party started at Mill Creek at approximately daylight and returned that night after dark. A great deal of trouble with slush ice was encountered. He could not say whether or not Kane Creek and Kane Springs are the same. (R. 2986.)

The point to which he went was the Shafer No. 1 [well]. As he recalls they had no serious difficulty with sand bars on that trip. (R. 2987.)

He afterwards made other trips on the Colorado River between those points in connection with business for the company for which he was working. His next trip was in August, 1925, when he made a trip down the river in a rowboat with an outboard motor with Virgil Baldwin, who was working for the Moab Garage. The trip was made down to the Frank Shafer well [No. 1], but he does not remember whether it was the same boat in which he made the first trip. A great deal of trouble was had on the trip because of sand bars in the river. (R. 2988–2989.) He could not say positively how long it took to make the trip because he started in the late afternoon on one day and returned the following day. The trip back started shortly after breakfast on the morning of the second day; and there was no business to take time on the way up.

The next trip on the river was in January, 1926, and he made a number of other trips every month thereafter through the season. (R. 2989.)

In January and February of 1926 he went down the river on trips with the Moab Garage barge which was then hauling considerable material. On the majority of the trips trouble with sand bars was encountered, the exception being when they did not encounter such troubles. The boat carried a winch and tow line to assist in pulling the boat off of the bars. He has seen the winch in operation a great number of times. (R. 2990.)

During the months of January, February, and March, except possibly two or three times, the up trip always got off the boat on the east side of the river about a mile and a half or two miles above camp, and walked into Moab instead of riding the boat, because it was quicker, and saved time; it was not near as tedious as riding up on the boats. (R. 2990–2991.)

During the months of July, August, September, and October he made a number of trips down to the mouth of Lockhart Canyon, drilling operations commenced there in the latter part of June. He made these trips on the Moab Garage barge a few times and the balance were made in a motor boat. Up until July or August he had always had one of the operators of the Moab Garage in the boat with him, but after that time he rented a boat from the Moab Garage and drove it himself. During the months of July, August, September, October, and November he was making at least three trips a month down the river to Lockhart and a greater part of the

time he was running the boat himself, but not always. It was sufficiently frequent, however, so that he gathered considerable information regarding the river. During these operations he observed that the channel changed very rapidly, that being very characteristic of the river, and from trip to trip he had to be very careful watching for the channel that was taken the day before and would very often be grounded. This condition was generally true on the trips made. (R. 2992.)

Changes in the water level of the river are most rapid during the months of July and August when there are numerous thundershowers, and freshets coming in from side streams. That is the time when the greatest trouble is had from bars.

The change in the stage of the water brought about a change in the bars because of the increase of sediment in the water. These streams coming in from the side, the water carries more silt, and change of speed of the current starts the shifting on the bottom of the stream. (R. 2993.) He has made trips from Moab to the Frank Shafer well [No. 1] on horseback but has never been below the well in that way. (R. 2993.) He has forded the river.

In running his own boat, coming upstream, their greatest difficulty is at points where bars cross completely across the river, making shallow water all the way, insufficient draft for a small boat, and becoming stuck on sand on these bars is quite com-

mon; especially in warm weather he would get out and wade across the stream, with an oar, clear across, and pick out where the water might be a little bit deeper, if he couldn't do it with his eye, where he might get my boat through without too much trouble. (R. 2993–2994.) He generally found a place where the water was a trifle deeper, but invariably those places were in a place where the channel was, the channel being in shallow water and it was necessary to drag the boat across; just a question of working your way through. (R. 2994.)

Cross-examination (R. Vol. 16, pp. 2994–3001):

River was invariably shallow clear across at these points where they had trouble and the channel would pinch out on them, invariably be shallow all the way across. (R. 2994.)

These spots were generally known from former experience, but not withstanding that, he did get out and walk clear across trying to find a channel, when he got stuck. Practically always found a place where we could get a boat through, but it was very limited, and very shallow water all the way across. (R. 2995.).

He rode horseback down to the Frank Shafer well only twice that he remembers.

His experience on the river covered the period from 1924 until November, 1928. (R. 2995.)

On the trips taken in January, 1926, he got out of the boat between a mile and a mile and a half

above the Frank Shafer camp on the other side of the river and walked the balance of the way to Moab. The Frank Shafer camp is approximately twenty-two miles below Moab and the trail was between eight and nine miles from the landing spoken of, to where he got off the boat at Moab. From the mouth of Mill Creek to Moab is about three-quarters of a mile to a mile. From the boat landing to Moab is a trifle over three miles. (R. 2996–2997.)

During the time he made a practice of walking up, he did not leave his car at the dock. His car was not always left at the dock when he walked but it was left a number of times. When he walked from the landing opposite the Shafer No. 1 well, he was not operating the boat, he was a passenger on one of the Garage boats. He did that a great number of times, but did not attempt to say how many. (R. 2998.)

During the months spoken of, he went down the river every week or ten days, and during the months in the early spring of 1926, and he would estimate he walked from the landing two-thirds of the time at least, possibly more. After the period spoken of he was not on the river regularly until the work at Lockhart was started. (R. 2999.) Assuming that he made trips every ten days, he would have walked to Moab twice a month.

He does not know whether or not his company has taken over the interests of the Midwest Company or a large part of the Midwest interests.

Technically, his company still retains its interests there. (R. 3000.)

It is his understanding that his company is one of the defendants in a suit commenced by the State of Utah and the Texas Oil Company against the Midwest Oil Company, Shafer and others. He was not a defendant in that suit and he does not have a permit himself. (R. 3001.)

Redirect examination (R. Vol. 16, pp. 3001–3002):

He was on the river at least once a month from the middle of September or the first of October until the latter part of October, 1928. He might have skipped a month but he would average at least a trip a month; and the times that he waded in the water to get the boat off from reefs, the water was from eight inches to a foot deep. (R. 3001–3002.)

There were two or three places between the dock [at Moab] and Kane Creek, during the latter part of the period 1927 to 1928, that gave a great deal of trouble. At times the channel would cut through. Other times it would be very shallow. (R. 3002.)

Further examination (R. Vol. 16, pp. 3002–3005):

At the times he speaks of the Moab Garage boats were being operated but not regularly, and they went through the same places. (R. 3002.)

His company had such supplies as fuel, gasoline, camp supplies, repairs, and some drilling

equipment, brought down by the Moab Garage boat. Most of the heavy drilling equipment, such as derricks and boilers, had been taken down the river on the barge previously. (R. 3003.)

His company was interested in all the wells drilled down there except the Snowden-McSweeny well, and included the Frank Shafer No. 1, the J. H. Shafer No. 1, the J. L. Shafer No. 1 A, and the Hazelwood No. 1. The Hazelwood No. 1 well is located at the mouth of Lockhart Canyon. He can't give the mile post at which the Snowden-McSweeny is located, but it is located about a mile back from the river, while the other wells are located on the river bank. (R. 3004.)

The purpose of being on the river in 1927 and 1928 was the same as for his presence, previous to that time. He was drilling the J. H. Shafer No. 1 well and conditions were similar to those that he has already described. (R. 3005.)

HERMAN ROSENFELT

For Complainant

(Record, vol. 16, pp. 3006-3014)

He is of San Francisco, California, and is a shipwright by profession, having been engaged in that occupation since 1871. He assisted in the construction of the boat known as the C. H. Spencer. (R. 3006.)

The framework of the boat was put up in San Francisco, put together temporarily, and then taken down. As taken from the blueprint of the

boat that he has, the hull is eighty feet long, twelve-foot wheel on the stern and six inches clear, making over all a length of ninety-two and one-half feet. The beam is twenty-five feet and the boat drew, fully equipped, from eighteen to twenty inches of water, light or empty. Construction started July, 1911, and was finished at the end of August. (R. 3007.)

The boat was taken to the Colorado River from San Francisco by rail and on the seventh of September he was asked to follow it and put it together. He started that evening and was gone six months and two days before returning to San Francisco.

He went from San Francisco to Marysvale, Utah, by train. The material for the boat had not yet arrived so he waited until it came and then loaded it on a wagon and went down to the mouth of Warm Creek. (R. 3008.)

The first team started out with four planks on a wagon and it required thirty-nine days to go to the mouth of Warm Creek from Marysvale. Four additional teams started the day after, one of which he accompanied, and it took twenty-three days to make the same trip. Three other teams which started later got to the mouth of Warm Creek fifteen days after the second four started. The first team with the four planks arrived sixteen days after the second four teams got there. Some of the teams made two or three trips, there being two carloads

of material to haul. The boat was set on the Colorado River at the mouth of Warm Creek. (R. 3009.) In his judgment the cost of the boat would be thirty thousand dollars. He was familiar with the cost of construction of boats at that time. The boat was equipped with steam power, but he does not know what horsepower. The boiler was about eight feet in diameter and ten feet long. After assembling the boat he launched it and two United States inspectors inspected the hulls and boilers, and helped launch the boat. (R. 3010.) Everything on the boat was satisfactory and the inspectors left after it was launched. He attended to a few details and then went home. The engine was brought to the mouth of Warm Creek and the boiler was brought in with sixteen yoke of oxen. (R. 3011.)

They had to try the engine before he could leave, and we went up and down there—kind of right in the river—traveled up and down there, went may be one hundred yards or so up and down. (R. 3011–3012.) The boat was constructed of Oregon pine.

Compl. Exh. No. 469 is a picture of part of the framework of the boat while under construction. The picture was taken right on the bank of the river. Photographs No. 467 was taken at the mouth of Warm Creek, and Compl. Exh. No. 468 was taken at the same place. (R. 3012–3013.)

The last time he saw the boat she was lying in a little eddy at the place where she was put

together. The boat was completed the latter part of February, 1912. He has not been back to Warm Creek or seen the boat since that time.

Coal for fuel was obtained twelve or fourteen miles up from the mouth of Warm Creek. (R. 3013.) The coal was hauled down to the river with bull teams and horses.

Complainant's Exhibit No. 470 received in evidence. (R. 3014.)

No cross-examination.

JEREMIAH JOHNSON

For Complainant

(Record, vol. 16, pp. 3015-3056; vol. 17, p. 3059)

He, "Jerry Johnson," whose temporary address is Hurricane, Utah, but whose home is at Lees Ferry, Arizona, was born in Glendale, Kane County, Utah. He was taken to Lees Ferry in 1876 when he was thirty-six days old and has been there practically ever since. (R. 3015.)

His father ran the ferry at Lees Ferry for twenty-two years. He then moved away in 1910, returned and has lived there ever since. He assisted his father in operating the ferry from the time he was old enough, as a boy about ten years old, until he ceased operations. Besides the ferry-boats he had row boats in which he made trips on the river from Lees Ferry. (R. 3016.)

One of these trips was to Bull Frog Creek about a mile above Hall's Crossing. There were four

boats, one eighteen feet long and the other fourteen feet long, bought in Chicago, taken on the trip. The largest boat was a motor boat but the motor did not work and it had to be taken up by man power. These boats belonged to Robert B. Stanton and the party consisted of fifteen men, only bedding and provisions for the trip being carried. (R. 3017.)

It was necessary to have fifteen men on four boats on account of the difficulty in pulling these boats up the river, in handling the boats. It took twenty-one days in making the trip from Lees Ferry to Bull Frog, which is about one hundred and thirty-five miles. (R. 3018.)

They were able to row the boats at short intervals between the rapids, there always being sand bars and rocks in the river to encounter. After delivering the boats, they secured two old boats and went back down the river to Lees Ferry. These were just common homemade rowboats, made of common river lumber, the larger one being about eighteen feet long and the smaller fourteen feet. As he remembers it the trip was made shortly after Christmas, 1898. The trip down stream required about two days. (R. 3018.)

He recalls a boat called the *Charles H. Spencer*, and had something to do with its operation. This boat was used for pushing barges from Lees Ferry to Warm Creek and for hauling coal. The barges were pushed up the stream, loaded with coal and then drifted down. He never made a trip from the

ferry to Warm Creek on the boat. He only helped some getting started, but has had experience with some other boats. (R. 3019.)

They built the *Chas. H. Spencer* at Warm Creek, came down to the ferry and back to Warm Creek. That was one trip. Down to the Ferry, and back to Warm creek, and down to the Ferry and tied it up, and that was the last it was ever used. It sunk. He saw it sink. (R. 3019.)

That was two and one-half trips, two trips up and two trips down. The barge built for hauling coal got away and went down the river. After that they used the ferryboat, inasmuch as there was not much travel at that time, the ferryboat being used for one trip.

The two times that the *Charles H. Spencer* came into Lees Ferry there were about five tons of coal in the hull which were never unloaded. It was used for firing the boilers. Before the boat sank they took some of the coal out and used it for blacksmith purposes and some was hauled away, about five tons altogether sank with the boat. (R. 3020.) He does not know exactly but thinks there were possibly seven or eight tons brought to Lees Ferry. He has forgotten just how long it was from the time the boat started to operate and the time it quit. The same outfit [Spencer] had a boat called the *Violet Louise*. This boat was about forty feet long and about six feet wide. The name of the company that operated the *Violet Louise* was the Nome Gold

Dredge Company. (R. 3021.) The boat was equipped with a forty-horsepower gasoline motor and propeller. It was brought to the Colorado River on a wagon and launched at Lees Ferry. He has seen the boat operated and has ridden around on it close to the ferry, but not on long trips. (R. 3022.) It went upstream to Warm Creek. He saw it come back in a flood from heavy rains, without any men in it; he went out and roped it and drug it ashore. They landed down below the Ferry.

They finally put the *Violet Louise* on a kind of sled they made, and drug it back up by the camp, and it is there yet, what is left of it, pieces lying around in there. (R. 3023.) When he roped the boat up it was probably about a mile below Lees Ferry and according to his recollections it was in 1912, the same year Spencer launched it there. He saw them take the boat back upstream after he had rescued it. (R. 3023.) After rescuing the boat a sled of poles was brought and it was dragged back up the shore with five yoke of oxen, and it was never put on the river again after that time.

The same outfit had another boat called the *Mullins,* which was a metal boat about twenty-four feet long and probably four feet wide and was propelled with thirty-five or forty horsepower engine. He saw the *Mullins* boat in operation going around the point on its way to Warm Creek [from Lees Ferry]. (R. 3024.) He never went to Warm Creek on the *Mullins* boat.

They run the *Mullins* boat at such a rate, the high speed and silt in the river cut the bearings out down by the propeller, got it to wabbling in the water, then they burnt the bearings out, and came back with the bearings burnt out, rowed it back. When they got back with it they got a fellow to rebabbit it, put in new bearings; they used it for a trip or two up the river after that. (R. 3025.) It was finally tied up at Lees Ferry where it sank in the sand and lay for years. It was finally dug out, repaired, and taken to Lake Mary at Flagstaff, Arizona, for a pleasure boat. He has never seen it since. (R. 3025.)

Besides these boats they [Spencer] had two small boats propelled with small engines of about ten horsepower. These boats got away and went down the river.

He only rode part of the way on the trips to Warm Creek on the *Charles H. Spencer*. He would help them get started, ride up a ways, and then come back to the ferry. At that time he was running the ferry for Charles H. Spencer and went up the stream on the *Charles H. Spencer* possibly four or five miles. (R. 3026.)

During the four or five miles that they went upstream with this boat, they encountered many difficulties; set three days one time on the sand. (R. 3026.) This happened a mile and a half or two miles up the river from Lees Ferry. It drug a

one-hundred-foot chain made out of five-eighths inch iron and they had to come down backwards and let this chain drag from the front, in order to hold them from spinning around in the whirlpools and getting on the sandbars; then they got on a sandbar. They always came down backwards, dragging this long chain in the sand. Whenever they stopped, they had to immediately take that chain in, or it would get in the sand and lose it. They lost two chains that way. (R. 3027.)

On the Stanton trip in 1898 he found the better water below Warm Creek. There were not so many rapids and swift waters there. (R. 3027.)

He was at Lees Ferry when Spencer's outfit brought in the dredge machinery. It was installed about one-quarter of a mile below the ferry. He worked on the dredge and it was constructed on two barges anchored out in the water. The dredge was operated on the sands in the river bed, some also being washed in from the side. They used coal for fuel when they could get it, when they could not get it they used drift wood. (R. 3028.) There was no coal brought in except on the boats. The *Violet Louise* never brought any coal down that he knows of.

While at Lees Ferry he was there practically the whole year around and had occasion to observe rapid rises in the river at that point. The amount of rise would depend on the locality. There the

river spread out, it did not rise as much as it did in the narrow canyons. At Lees Ferry he has seen at least a foot rise an hour for twenty-four hours. (R. 3029.) This occurred in October during the heavy rains in the mountains. He has also observed rapid rises in the river in the spring of the year, due to melting snow.

During one year in 1884 it rose higher than it was ever known to before or since. He was there at the time but was only a small boy and does not exactly remember it. (R. 3030.)

He has subsequently seen the marks on the banks where it came in 1884; the government surveyors had taken their point from that. There was a tree in the orchard that had a fork just above where the water line came on that tree. It is a dry stump now, but still stands there. He showed them where the water stood on that tree. They took their starting point from there, and they made it the beginning point to estimate all the way along the river to where this high water came to. (R. 3030–3031.) He is unable to say exactly how many feet it rose, but thinks it must have been twenty or twenty-five feet above the low-water mark.

Besides working on the boat he assisted Mr. Stanton in doing road work to apply as assessment work on the claims. The road work was done a few miles above Lees Ferry in the canyon in Arizona. (R. 3031.)

He made a trip with Mr. Mairs from Lees Ferry to a point about twenty miles above (R. 3032-3033.)

Cross-examination (R. Vol. 16, pp. 3033-3047):

At the time of the big flood in 1884 he was approximately six years old, and is positive he did not get his trees mixed when showing Mr. La Rue where the water came on it, because this tree was in a garden and it was an old landmark, and he marked it, cutting a notch with an axe at the point where the water came. (R. 3033.) This notch was cut in the tree a number of years after the flood, when he was getting on toward manhood. The notch was pointed out to Mr. La Rue, Mr. Gerdine, Mr. Fowler, and Mr. Dudley, and it was not on the occasion of the visit of these gentlemen to Lees Ferry that the tree was marked, it having been done many years prior to that time.

He has been up [the Colorado River] only once as far as the mouth of the San Juan, that being the time when he went up to Bull Frog. (R. 3034.)

He made one trip about sixty miles above Lees Ferry and another about thirty-five, at which time he ran a motor boat for the Edison Company engineers. These last two trips, however, did not reach above the Utah-Arizona line.

He recalls only one trip that he made above Warm Creek, other than the one up to Bull Frog, this trip extending five or six miles above Warm

Creek. The trip was made in a rowboat, as was the trip when he went sixty miles above Lees Ferry. (R. 3035.) The fifteen men who went up to Bull Frog with him also came back with him. The trip was made because Mr. Stanton was operating or planning on operating some dredges on the Colorado river and mining some placer gold in the bed of the river. After he had got these boats and part of the supplies there, he changed his mind, and decided to move his camp up to a short distance above what is known as Hall's crossing, about one hundred and thirty-five miles. (R. 3036.) After getting to Bull Frog they rested a day and then returned to Lees Ferry. The water was at practically the same stage at both the up and down trips.

Of course, when you run on a sand bar you get out and pull your boat off and gone again. They went right along where they did go. (R. 3036–3037.) It was not necessary to be held up long at a time because there were so many men to help out and they moved right along.

In going up, as stated, the motor was not used at all, the boat being poled, rowed, or towed. (R. 3037.) Where the water was not so swift, favorable conditions, they would row. (R. 3038.) Trouble with sand bars is less going up the river than in coming down. This trip up the river required twenty-one days time. (R. 3038.)

He is familiar with the Johnson outboard motor, having run one on the river. They are equipped

in such a manner that the silt in the river does not get into the motor and cut the bearings, and the propeller pin is small so that when the propeller strikes bottom the pin is sheared before the shaft is twisted. This pin is easily repaired. (R. 3039–3040.)

Q. Now, returning to the question I put to you, I wish you would answer that, Mr. Johnson, whether it is not a fact that with an ordinary rowboat and a load of, say, a thousand pounds, the boat being equipped with one of these stock Johnson outboard motors, there would be any difficulty in navigating the Colorado River up and down from Lees Ferry? (R. 3040.)

The boat would run fine between rapids. (R. 3041.)

Run fine until they come to a rapid. Then you got to get out and tow the boat around the rapids, put your motor in the boat and get your ropes out and tow it.

"Q. That would depend on the character of the rapid, wouldn't it?

"A. The ordinary swift rapid which they will encounter." R. 3041–3042.

He does not remember the number of rapids that had to be towed around, but there were several.

(Defendant's Exhibit No. 12 was identified by witness as being a letter he wrote. R. 3043.)

There are rapids that could not be boated with a Johnson motor between Lees Ferry and the mouth

of the San Juan River. (R. 3045.) One or two of these rapids are between the Utah-Arizona line and the mouth of the San Juan. He went up one little rapid; had two Johnson motors with the boat with a ton on; had to pull it up with a winch; tie the rope ahead about two or three hundred feet, and pull it up with a winch. (R. 3046.)

The Johnson out-board motor that he had in mind when he wrote the letter [Defendant's Exhibit No. 12] was a ten horsepower motor. (R. 3047.)

Redirect examination (R. Vol. 16, pp. 3047–3051):

"The SPECIAL MASTER. This is Compl. Exh. 471?

"Mr. BLACKMAR. Yes, sir.

"Letter addressed to Mr. Jerry Johnson at Lees Ferry.

"(Reads:)

" 'Recently Mr. Spencer of Los Angeles informed me that you had first-hand knowledge of the construction and operation of a large steamboat and a thirty-foot launch which was operating various times between Lees Ferry and the mouth of the San Juan.

" 'I am representing the State of Utah in the field preparation of their defense in the case of United States versus the state, and involving operation of boats on the Colorado, Green and San Juan rivers.

" 'Will you please write me, outlining your experience on any of these rivers, and particularly

your knowledge of boats which work between the Ferry and the San Juan.

" 'Yours very truly,

" 'ACTING STATE GEOLOGIST.'"

"Mr. BLACKMAR. That is signed by you, Mr. Burdick?

"Mr. BURDICK. Yes, sir." (R. 3048–3049.)

A boat [Johnson out-board motor] could not be taken over the Rock Creek rapids without towing, nor could it be taken over the Bridge Canyon rapids without towing. (R. 3049.)

Navajo Crossing is a shallow place in the river where a ledge of rock crosses it. By shallow water he means so that it can be waded or crossed by horses. Navajo Crossing is above the mouth of the San Juan River and the time he went up with the Stanton party is the only time he was ever up there.

A boat with a Johnson out-board motor attached could not be boated over the Bull Frog Rapids without towing.

During all of the time that he and his family lived at Lees Ferry, he never got any household supplies from either up or down the river. All of the supplies being brought in from Flagstaff [Arizona], and Marysvale, Utah, formerly by wagon and later by truck. (R. 3050–3051.)

Recross-examination (R. Vol. 16, pp. 3051–3054):

He remembers taking a boat over the ledge but does not know how far it is from Bull Frog Rapids.

The boats had to be dragged over the ledge [worked them over]. Had to get out and push; they got out, unloaded the boats coming down, and portaged the supplies. (R. 3051.)

Portage around the ledge was made in Utah on the right-hand side of the river coming down. All of the men got out of the boats and they were let down carefully. He is not prepared to say exactly how wide the ledge is but as he remembers, the water gets shallow for about one hundred feet and then drops into deep water. He did not go clear across the ledge as he could see where the water line on the other side was. It was in a water falls but you could see where the water tumbled going over the ledge. (R. 3052.) There is a little drop but not a great deal.

It was a place where the Navajos used to drive their cattle across but they did not have a ferry boat there. The walls of the canyon near this ledge crossing are not so high as they are below, and the river is more accessible from the back country. He saw the old trail leading down to the river. (R. 3053.)

When he answered Mr. Burdick's letter he endeavored honestly and frankly to answer it and to make statements of facts as he understood them to apply to the case. He had no reason to mislead Mr. Burdick and he endeavored to make a statement that would enlighten his knowledge. (R. 3054.)

Further examination (R. Vol. 16, pp. 3054-3056):

The ferry operated by him at Lees Ferry was operated by the Mormon Church. After 1910 it was necessary to keep an accurate account and report to the county officials of all the crossings and the funds collected.

For ten or fifteen years prior to 1910 there was quite a bit of travel into Arizona and Mexico from Utah, more then than at the subsequent period until automobiles started, and he thinks there would sometimes be one hundred to one hundred and fifty wagons a year cross the ferry. After 1910, when he ran the ferry for the county, it did not begin to pay expenses, did not even pay his wages. (R. 3055.)

In 1925, 1926, 1927, and 1928 an average of four hundred automobiles a year were crossed. Most of this traffic crossed during the deer hunting season in the Kaibab forest. Besides automobiles there were wagons and pack outfits. These vehicles were carried across for compensation and during the years mentioned [from 1910 on] he was in the employ of the county and was paid a salary. (R. 3056.)

Further recross-examination (R. Vol. 17, p. 3059.)

Navajo Creek is below the ledge crossing known as Navajo ledge. (R. 3059.)

Redirect examination (R. Vol. 17, p. 3059):

Navajo ledge is above the mouth of the San Juan River. He does not know how far. (R. 3059.)

FRANK T. JOHNSON

For Complainant

(Record, vol. 17, pp. 3060–3100)

He resides at Hurricane, Utah, and truck driver for Mr. Stanley Bradshaw. Born at Lees Ferry, Arizona, in 1879 and lived there until 1896 when went out and returned in July, 1910, and remained until 1923. (R. 3060.) Helped brother (Jeremiah Johnson) run the ferry.

Helped his father operate ferry prior to 1896. They ran the ferry with a long sweep, one each side, and one at rear to steer by; current ran the boat but it had to be held at a certain angle. His job was to get the rope and tow the boat upstream, while his father held it out from shore around rocks and sand bars. (R. 3061.) He generally took the oars on upper side when they got up the river, as that was the least difficult to handle. Prior to 1906 the ferry was not cable; James S. Emmett had the cable put in.

In 1896 and up to that time there were no other people living at Lees Ferry except his father's family and those who helped him. All supplies came in from railroad to north, at Salina, and went out by the way of Kanab by team and wagon.

He remembers the boat called *Charles H. Spencer*. Saw it land about ¼ mile below the ferry-boat cable. The first time he saw it, it had a few wagons and some machinery on it. (R. 3063.) Boat was tied up early part of 1912, with a plank

from the boat to the shore to keep it from getting too close to rocks. (R. 3064.)

The boat built at Warm Creek. It came down river to the ferry and made two round trips after that. There was some coal in bins on the last trip. Saw that boat had some coal on it.

He recalls another boat, the *Violet Louise*, a wooden boat about 40 ft. long; about 200 yards below the ferry, where it started out. They loaded the scow to push or pull up river, and the *Violet Louise* and scow passed out of sight, and was gone several weeks; when the boat started up stream Charles H. Spencer was on board. (R. 3066–3067.) The *Violet Louise* came back floating down the river. Did not see it until after it was caught and tied. (R. 3067.) He does not know how Mr. Spencer returned to Lees Ferry on that trip. (R. 3067–3068.)

His testimony the same as his brother's regarding the Mullins boat. (R. 3069.)

One ferryboat was built and taken up the river, and he never saw it again. The boat was 14 ft. wide, 40 ft. long, deck over the top and a railing on each side with an apron at the ends.

After 1910, ferryboat often encountered sand bars crossing the river. The bar was sometimes nearly half way across the river; would work probably 3 hours getting the boat to shore. That night or next morning, the bar would be entirely gone. A few days later there would be another one in the same place, continually changing. Sometimes

bar would come in the fall, and stay all winter; other times it would wash out in a few hours and form back again in nearly as short time as it went out. Rearrangement of sand bars would occur in July or August, whenever rain commenced. (R. 3071.)

After 1910, supplies came from Grand Canyon Cattle Company and were hauled by wagon and team from Marysvale.

He has been up overland to Rock Canyon, 50 to 60 miles above Lees Ferry, but only by boat up the Colorado River, about 7 miles. He has packed supplies to Survey camp of Southern Edison Company. (R. 3071–3072.) One trip he went to the river and got supplies off the boat. (R. 3072–3073.) Pack train went to Lees Ferry once a week for supplies; on survey two months in 1921. Went from mouth of Rock Creek to Lees Ferry by home-made rowboat which had been brought up and left there. (R. 3072–3073.) Went down twenty miles to another camp. In December he returned to Lees Ferry, and from Rock Creek they went to another camp, from the latter camp he was a day and half reaching Lees Ferry. (R. 3074.)

Down from camp 20 miles below Rock Creek to Lees Ferry, they encountered sand bars at Mexican bar. Landed at another point and worked the boat off the bar. There are a number of places an outboard motor would not work on account of hitting the sandbars. There were places where

the bottom of boat dragged in sand. (R. 3074–3075.) The place where they worked boat off the sand, was several miles above Warm Creek. (R. 3075–3076.)

Cross-examination. (R. Vol. 17, pp. 3076–3094):

The supplies brought to the survey at Rock Creek by pack train. (R. 3077.) On one trip supplies were brought down the river. (R. 3077.)

When the survey was finished arrangements were made for a boat to take them out. The pack outfit had been fired, and the boat was only way to get out except by walking or to go back by horseback. (R. 3078–3039.)

The easiest and most practical way to get back to Lees Ferry, was by horseback. (R. 3083.)

When he saw the *Charles H. Spencer,* there was in addition to a few wagons, some kind of machinery. He can not say what it was but it was more heavy than bulky. He does not recall the dimensions but he does remember there was one small steam engine. (R. 3085.) He knows there was something else besides the wagons.

The ferryboat was taken up the river just once by the company and both the *Violet Louise* and the *Mullins* boat took the ferryboat upstream. One of them, he doesn't remember which one, was tied to the side and the other was used to pull it or to steer it, he doesn't remember whether it was tied ahead or behind, but he believes it was tied behind. (R. 3086.)

When the ferryboat went upstream it had a pretty fair load on it consisting of wagons but when the ferryboat came back down neither of the boats were tied to it, it came down alone. The men in charge were poling the boats and they had some coal on it. (R. 3087.) He doesn't know how much coal and he saw nothing else but it had been taken up for the purpose of bringing down a load of coal and he has no recollection of seeing any coal on the *Charles H. Spencer* except one occasion when there was some coal in the bunker behind the engine. He never saw any coal on the deck and if there was some other trip when the *Spencer* came down with coal loaded on the deck he did not see it. (R. 3088.)

He saw the boat on three separate visits after it had landed. He never saw it in operation and between the times he saw it he knew it was absent from Lees Ferry and had gone somewhere and he had an opportunity to see the deck and was quite curious to look it over whenever it came. (R. 3089.)

At the point where he operated the ferry there is one side of the river just above the ferry, a wash that comes in and has formed a projection into the river and has washed some big rocks in and this forms an obstruction to the flow of the river on that side, but the bar that caused him trouble formed on the opposite side of the river. This wash comes in on the same side of the river as his home was located and is on the right hand side of the river facing downstream. (R. 3089–3090.)

While he was living at Lees Ferry he remembers a man by the name of Nathaniel Galloway and he has seen him come down the river two or three times. He was a trapper and hunter and once in a while there would be someone come down the river from above. He doesn't recall their names except Mr. Bert Loper came down once. (R. 3090–3091.)

The first time he remembers seeing someone coming down was when he was a good sized lad somewhere around fifteen years old. This was a man by the name of Meskin and as near as he can recall Galloway was the next man that came down and then there were two other men and that is all he recalls seeing before his father left there.

He believes that he only saw Galloway once before this time. Galloway came down afterwards while he was there apparently on a hunting expedition and he hauled him out to Kanab. Besides the above instance he believes that he has seen three others up to 1923, when he left there the last time. (R. 3091–3092–3093.) They were not all trappers; Galloway would come down trapping for foxes, anything he could catch that way; one old man, does not remember his name, he came down just for the thrill, you might say, and then there was another man that came down, went right on by. Some of the parties from the camp run out and hollered at him. He picked up his gun. Don't know what he did it for. Those were the only ones he remembers going down since he went

back in 1910. One other comes to my mind, the Kolb brothers; he saw them go down. (R. 3093.)

Redirect Examination (R. Vol. 17, pp. 3094–3097):

He remembers that when Mr. Galloway came in the first time that there were two men with him. He doesn't remember what kind of boats they had as he was only a small boy. He knows they stayed for sometime at the ferry and he doesn't know where they were when they left. (R. 3094.)

He does remember, however, that their boats were there for several years afterwards. They were just small open boats decked over with canvas as he remembers it. The canvas came over the ends and would just leave a space open where he sat. It was the last time Galloway came down that he took him out to Kanab. (R. 3094–3095.)

He doesn't know where Galloway carried on his trapping operations, but he knew he had some skins with him on his last trip.

In the three other parties he mentioned that came down the river he included the Kolb brothers and the next was the party who had the rifle, and the third outfit was an old fellow by the name of Barnes. (R. 3095–3096.)

The Colorado River at Lees Ferry at certain times carried considerable driftwood and it varied from trees six to eight feet through down to very small pieces. It is of all sizes and all kinds of wood,

mostly cottonwood, box elder, willow, and some pinon cedar, and once in a while planks, big sawed timber, and bridge timber.

He knows that Spencer used wood almost entirely in connection with the operation of his dredge, and just below the ferry there was a big gravel bar that spread out in the river sometimes between three quarters and a mile [long]. There would be a lot of wood on this bar, and while he was there he would take practically all the wood that was of any value and haul it to his barge for fuel every time the river would raise. (R. 3097.)

Recross-examination (R. Vol. 17, pp. R. 3098–3099):

On the first occasion he saw Mr. Galloway come down the river he doesn't remember whether Mr. Galloway told him where he had come from or not and he has no recollection of having asked him or having been told where he came from. On the second expedition Mr. Galloway told him he had come from Greenriver. He doesn't know whether he means Green River, Wyoming, or Greenriver, Utah, but he had come down the river.

He doesn't know whether the old gentleman by the name of [Barnes] who did not know where Cataract canyon was, died or not. (R. 3099.)

Redirect examination (R. Vol. 17, p. 3099):

Neither Galloway nor any of the rest of these men went back up the river in row boats that he knows of. (R. 3099.)

Further examination (R. Vol. 17, p. 3100):

There is a regular road from Lees Ferry to Salina and Marysvale; Salina is further up on the Sevier river; later the railways was built to Marysvale. There is a regular wagon road from Lees Ferry to Marysvale, by way of Kanab. (R. 3100.)

JOHN W. PALMER

(Record, vol. 17, pp. 3101–3121)

He resides in Cannonville, Utah. He is a carpenter and farmer and has been employed as a carpenter for the last five years by the Union Pacific Railroad Company.

He has had experience on the Colorado River between Lees Ferry and Warm creek. (R. 3101.)

He first came to Lees Ferry, July 7th or 8th of 1911, and remained there fifteen days at that time, and was just roust-about around the machinery, helping around. That was the same company that Charles H. Spencer was connected with.

Prior to going to Lees Ferry that year he lived at Clovis, New Mexico. The last time he went into that country he landed at Marysvale [Utah], October 8, 1911.

The purpose of his trip then was to unload three boilers and two pumps. (R. 3102.) The two boilers and the two pumps were hauled to Lees Ferry and one boiler went to the mouth of Warm creek.

He returned to Marysvale for eight or ten days, and Mr. Spencer and Mr. Parkins met them at Marysvale, made up a pack trip, and went from there to Paria. The Englishman and Mr. Parkins and Mr. Spencer went to Warm creek. He went overland to Lees Ferry with the pack outfit. (R. 3103.) The Englishman went down to look at the boat. (R. 3103.)

In the fall of 1910 he went into the San Juan Country (R. 3103–3104.), and built a wagon road about thirty-five miles down the river from Mexican Hat. This work he did as an employee of the American Placer Corporation.

He remembers the boat called the Charles H. Spencer. He was employed on the boat as assistant fireman. He went on board the boat at the mouth of Warm creek, and this was the boat's second trip. He then went from Warm creek to Lees Ferry. (R. 3104.) He left one day about one o'clock and got into Lees Ferry the next day about four. (R. 3104–3105.) On that trip were stuck on sand bars, couldn't handle the boat, just go around, until we put a big log chain on it, drug out in front to hold the nose of the boat straight up river; had to back down. (R. 3105.) The log chain was about one hundred feet long, maybe more.

The *Charles H. Spencer* boat made two and one-half trips altogether, and he made one trip and a half on it; carried wagons and equipment they had at Warm Creek around the coal mine, wagons

mostly. (R. 3105.) There was no barge or other boat hooked up with the *Charles H. Spencer* boat at the time he made the trip. (R. 3105–3106.)

After arriving at Lees Ferry with the *Charles H. Spencer* boat he remained over night and went back the next morning to Warm Creek. This trip back upstream took about two days.

The log chain was not used on the upstream trip. He did well to get back with the boat, without dragging the chain.

After returning to Warm Creek they made another trip on the *Charles H. Spencer* down to Lees Ferry with a cargo of about five tons of coal. This trip was made in a day. The rock chain was used on this downstream trip. After completing this last trip to Lees Ferry he left that place right away (3106), and went to Paria.

There was two companies in there, one called themselves the Paria Mining Company; he went up there and stayed at their mill. (R. 3107.)

He did not return to Lees Ferry after that except maybe once or twice a year, and these trips to that place have been made every year except for the last two or three years.

The *Charles H. Spencer* has remained at Lees Ferry. (R. 3107.)

He has been to the small mine on Warm Creek, the one that was mined first. There were about one hundred tons of coal at the mouth of Warm Creek the last time he was there.

He has not been right down in Warm Creek since that time; but he has been on top of the ridge. (R. 3107.) He has been near enough to see that coal and it is all covered up with sand. (R. 3107–3108.)

He does not know anything about the operation of the boat known as the *Violet Louise*. His operations were confined entirely to the *Charles H. Spencer* boat.

Coal was taken from Warm Creek to Lees Ferry by other means than the boats; he packed it over with pack train. Had three mules and a saddle horse. Carried about two hundred pounds to the animal, six hundred pounds to the trip. (R. 3108.) This trip with the pack outfit that carried the coal, was made a few days before he went on the last trip of the *Charles H. Spencer* boat, which was the latter part of March of 1912. (R. 3108–3109.)

There were fifteen men at the camp which was established at Warm Creek while he was working there that winter. The supplies for the camp were brought in by wagon from Marysvale [Utah].

He was on the *Charles H. Spencer* boat once when it tried to go upstream. Got about a quarter of a mile above the mouth of Warm Creek.

Then came back to Warm Creek, got stuck on a sand bar; couldn't go any further. (R. 3110.)

When he went to Lees Ferry on the last trip made by the *Charles H. Spencer* the boat was made fast to the shore with ropes tied to a big rock on the bank. (R. 3110.)

When he was on the San Juan River, the supplies were brought in by pack train from Bluff City and Mexican Hat. (R. 3110–3111.)

Cross-examination (Volume 17, pp. 3111–3121):

He was referring on that occasion to the time he was building the road in the San Juan country. The road was built from a bar about thirty-five miles from Mexican Hat, and it was built down the river. This road was in the nature of assessment work on mining claims. The road was not part of the main traveled road. There was no other road in there. (R. 3111.)

He doesn't know and never asked where they were going when he made the trip with the *Charles H. Spencer* in the attempt to go upstream. This trip upstream was made just before the last one downstream on the same boat.

When they found they couldn't go up the river they came back and went right on. Went right down to Lees Ferry. Had a load of five tons of coal. There was about six of them; does not remember who they were. Spencer left them at Warm Creek. He didn't go back down the river. (R. 3112.) Spencer made the one trip with them. (R. 3112–3113.)

And the reason that on the last trip of the *Charles H. Spencer* it went upstream about a quarter of a mile and then turned around and went down to

Lees Ferry was because couldn't go any farther. They wanted to go up farther. (R. 3113.)

He did not know what point he [Spencer] was making for. He didn't know a thing about it, he just started to go up the river, that's all he knows (R. 3113.) They were up a quarter of a mile and turned around and went downstream. They left Warm Creek on that trip early in the morning, as early as they could get away. He doesn't know how early. This trip was made in the latter part of March, spring of the year. (R. 3113.)

They arrived at Lees Ferry late that afternoon, just before sundown; the sun was getting very low. (R. 3114.) It was seven or eight o'clock before they got away. It was daylight when they left and daylight when they arrived. He has refreshed his memory after talking with someone else and it was early in the morning when the trip was started and they arrived at Lees Ferry late in the afternoon. (R. 3114–3115.)

The sand bar which they ran into a quarter of a mile above [Warm Creek] was on the south side [of the river]. During that day they also ran into a rock but did not run into any more sand bars on the quarter of a mile trip down to Warm creek.

On the trip down from Warm creek to Lees Ferry they would run into sand bars. They were on one about three or four hours, which they ran onto along in the afternoon.

They were over the Utah-Arizona line when they struck that; the Utah line is at Warm Creek. (R. 3115.)

On the trip that he made with the pack train hauling about six hundred pounds of coal overland, he was called off that trip and put on the boat. (R. 3116.)

He took the pack train out later along in the summer; he was looking after the stock; when he quit the boat he got that stock and had charge of it again. (R. 3117.) When he speaks of the pack train he means the three mules and a horse. They used this pack train to take the coal from the mine down to Warm Creek. Used pack train to make trips down to the ferry once in a while, down into that country, Warm Creek, Lees Ferry country. (R. 3117.) Excursions were made on various missions with this pack train. (R. 3117.) The last time he was at Warm Creek there were two piles of coal, each of about one hundred tons; one at the mouth of Warm Creek and one at the camp. (R. 3117–3118.) Those piles of coal have not been taken away. The coal is still there and it is buried in the sand; the wind has blown the sand, and the water from the Colorado has covered up the other pile with silt and sand. (R. 3119.) The last time he was at Warm Creek was in 1916. He could see the sand piled up over it; he knew where it was. (R. 3119.) The sand had drifted right up where the coal was. (R. 3119.) He has good reason to

believe that the coal was there because nobody ever moved it. (R. 3120.)

The coal was never taken off the boat, *Chas. H. Spencer*, that he knows of; carried the coal down in front of the boiler, down in the basement; didn't have any coal piled any other place. (R. 3121.)

Edward C. Sumner

(Record, vol. 17, pp. 3122-3130)

Resides at Cedar City, Utah; 53 years old; manufacturer of soda water; has following mining, livery, garage, and pack-horse business.

Son of John Summer who was on Powell Expedition. (R. 3122-3123.)

Never did any boating on Green River. Has been on Green River at Greenriver, at Vernal, at Brown's Park, and Ouray.

Was on Colorado River, during winters and spring of 1897-1898 from Hite, Utah, to Hanson Creek; there in fall of 1895; placer mining for Good Hope Placer Mining Co. (R. 3123.)

Went down Trachyte Creek from Hanksville in wagon and pack animals; himself and partner, Frank Bennett.

Good Hope Company had an ordinary, flat-bottom boat, 10 ft. long 4 or 5 ft. wide. (R. 3124-3125.)

Has seen boats taken upstream, towed along bank; wind fairly good, sailed up the river.

From Good Hope to Olympia Bar, 12 or 15 miles; going back upstream, had a pole and piece of carpet for sail; wind strong; just a question then of dragging boat along banks, first one and then other side of the river. Plenty of swift water between Olympia and Good Hope Bars, fast water. (R. 3125–3126.)

Trail along opposite side of river from Olympia bar; pack outfit from Good Hope to Hanson creek, not necessary to cross river. (R. 3126–3127.)

Summer of 1898 Mr. Stanton came with drilling machine to test bed rock of Colorado. Brought supplies for Stanton outfit in by wagon from Greenriver, he had nothing to do with transporting Stanton's supplies. Stanton built a flat-bottom boat, quite large, for drilling machine; come down and drill across bars; drop boat down and pick up machine below it and go over the still water; crossed rapids with a cable. (R. 3128–3129.)

No other boats in there but skiffs.

Has been down river to mouth of Hanson Creek, 4 or 5 miles below Olympia Bar, fartherest point he has been. (R. 3129.)

— *Cross-examination.*

Supplies brought by wagon from Greenriver to Trachyte Creek; boated from that point.

He and Frank Bennett (who was his partner) were together all the time he was speaking of. (R. 3129–3130.)

T. CUMMINGS BENNETT

For Complainant

(Record, vol. 17, pp. 3130–3170)

Resides at Lund, Utah; hoisting engineer at a mine.

Experience with boats on Osage, Missouri, and Colorado Rivers.

On Colorado River, July, 1920, at Hall's Crossing; came by wagon from Richfield and from Hall's Crossing to Hite on horseback. There is a regular road from Richfield to Torrey, Utah. Purpose in going down river to work for Henry Mountain Oil Co.; operating 100 miles above Lees Ferry. (R. 3131.)

Built a raft of material which had been shipped from Greenriver to Hite and been taken down to Good Hope. (R. 3132.) Raft 14 feet square, lumber; drew 7 or 8 inches of water. Loaded with pipe at Good Hope Bar; Frank Bennett, an uncle, was with him. Loaded a wagon and stove on raft at Olympia Bar. Between Good Hope and Olympia Bar, downstream, raft hung up once on sand bar; swung off; when wagon and stove were loaded on raft it was too heavy and raft sank; unloaded and built more raft; went down river to Bull Frog rapid, nearly crashed into wall rock; at Hall's Crossing, landed raft and unloaded it. Proceeded down river with rowboat they had along with raft. (R. 3134.) Below Lake Canyon rapid is a large

whirlpool; boat got in whirlpool attempting to get out of large waves of the rapid; impossible to row, lined boat out. Went on down to Rincon.

Came upstream from Rincon to Hall's Crossing with Frank Bennett, William B. Hay, and John Rottinhouse. (R. 3135.) Below Lake Canyon Rapid water too swift to row over; climbed a ledge, they threw a line to him, and he pulled them over. Not a rapid, just swift water. At rapids water too swift, so lined over. Distance covered 20 to 25 miles; required 2 days' time. Towed practically all the distance; towing easier than to row. (R. 3136.)

Uncle and others built raft of part of drilling rig, of all the wooden parts of rig and went down Colorado to Rincon; he went overland with horses. Supplies received, brought from Hall's Crossing, partly by boat, partly by pack over trails; supplies came from Torrey to Hall's Crossing by wagon. Helped drill well; deepest 140 feet, located 150 feet from water's edge. (R. 3138.) (Compl. Ex. 11–D, photograph 221.) The rig would sit in left-hand corner of picture; drilling carried on around point shown in picture No. 222. Unable to identify photo 223. (R. 3141.)

The well that was sunk one hundred and forty feet was located above high-water mark. He is able to fix this mark because there is quite a shelf

of sand there with vegetation growing on it and the well was above the vegetation.

About the 8th of October, 1920, he made a trip upstream from Rincon, accompanied by Frank Bennett and W. B. Hay. (R. 3141.) They used a rowboat about sixteen feet long, three and one-half or four feet wide, and two feet deep. The trip was made a distance of about eleven or twelve miles up the river, and required a day to go up. Progress on this trip was made by rowing, towing, and poling.

The purpose of the trip was to bring the raft down the river that was stuck in Lake Canyon rapid. He did not pay any particular attention while there to the Lake Canyon ledge. In getting the raft out it was necessary to get off into the water. (R. 3142.)

Where the raft stuck the water was very shallow, being about knee deep. He had on an ordinary pair of high-top rubber boots and was there quite a while before he got wet. The stream there had a rocky bottom and in getting the raft off they moved it down and out into the river. It was necessary to move the raft about twenty feet forward before they got it into deeper water.

After getting the raft off the ledge he accompanied it down the river, and on this trip down they were hung up at Shock Rapids. (R. 3143.)

The raft was about twenty feet long, eight or ten feet wide, built of logs fastened together with

ropes or cables in order to make a kind of hinge in it. This was done so that the raft would be flexible, which is an assistance in getting over rocks and rapids. The raft carried a drill stem that weighed eighteen hundred pounds and a few drill bits. (R. 3144.)

Further examination (R., Vol. 17, pp. 3144–3146):

The drilling equipment was run by a small gasoline engine that had been taken down by Mr. Bennett [Frank], Mr. Hay, and Mr. Rottinhouse on a different raft from the one that took the drill stem down.

The first raft carried the drilling rig, which consisted of an engine, a bull wheel that was made of wood, the frame that was built into the raft, and some iron wheels. The raft was built in three or four sections, was about ten feet wide and forty to forty-two feet long, and was loaded with an engine, one drill stem and a set of jars and bits. (R. 3145.)

There was a boat along with the raft, but it was unnecessary to pull it inasmuch as the water was high, it being the latter part of July. The raft was steered with the rowboat.

On the trip down he had two drill stems that he remembers of in the boat. They started out with them on the raft, but they got hung up at Lake

Canyon Rapids and the stems were transferred to the boat at that point. (R. 3146.)

Further direct examination (R. Vol. 17, pp. 3146–3154):

The first raft referred to was fastened together with ropes and cables. The equipment carried on these rafts weighed five tons; that is, freight was paid on that weight for wood, iron, and all.

Got hung up on Shock Rapids; went down and unloaded our boat on an island at the lower end of Shock Rapids; came back up to the rapids; tried to pry it off, but couldn't, so unloaded the stuff from there into our boat, took it on down to where had left the other at the lower end of the island. (R. 3147.)

In getting off at Shock Rapids it was necessary to get into the water, which was about knee deep, and the rocks sticking up in it are what hung up the raft. It was necessary to carry the raft forward in order to get it off the rocks.

It was quite a ways through there; probably stretches where it would float for fifteen or twenty feet, then hang up again. They would try to pry it off and go on down. Maybe it would go one hundred feet at a time. That stretch of water through there is probably one-eighth of a mile long, the bad part. (R. 3148.)

They finally arrived down at Rincon, after being hung up on a rock in the middle of the river below Shock Rapid, where they were held for some

little time. They couldn't touch the bottom with an oar. (R. 3148.) The rock was submerged, not visible.

In November of the same year he made another trip upstream to Bull Frog rapid, from Rincon, a distance of about twenty-four miles. The trip up required two days because of a stop part of one afternoon to explore some old ruins. This trip up was made by rowing, towing, and poling, as before.

At Bull Frog rapid they built a raft from parts of the cabin of an old dredge that was there. (R. 3149.) The raft was about twenty feet long, ten feet wide, two sections of it possibly a foot thick. It was made of flooring lumber and two-by-fours stacked one on top of another and nailed together three deep. The raft was fastened together by ropes and cables and carried no load whatever, the three men riding in the boat.

In going down to Rincon the raft was hung up on a bad rock below Lake Canyon rapid and it was necessary to pole it off the bedrock until they got it below where the bedrock sticks up. (R. 3150.) To do this it was necessary to get into the river, which they waded clear across, and the greatest depth they found was about two feet of water and that only in stretches, the widest not being deep enough to get the raft through. They thought they were in the channel but weren't positive about it and couldn't even pole the raft through.

The bed at that place is all rock bottom.

At Shock Rapid the raft ran aground and was broken up on the rocks. The parts were caught below, reassembled again, and taken on to Rincon. (R. 3152.)

Went upstream in December from Rincon to Hall's Crossing with Mr. Hay; had same proposition of towing, rowing, and poling; river shallow, waded most of distance and towed boat up; Mr. Hay poled from stern (R. 3152); returned to camp April of next year (R. 3152). Went to Rincon by pack horses. (R. 3152–3153.)

Supplies from Torrey went to Baker ranch, about 12 miles back from Colorado River, on Hall Creek (Hoxie Creek). Made a trip back in March or April, 1921; remained there until May. Went out on horseback to Salt Lake City. There is a trail down to the river through Navajo Gulch. (R. 3153.) Has not been back on Colorado since that time. Did not find oil in commercial quantities. (R. 3154.)

Cross-examination (R. Vol. 17, pp. 3155–3167):

It is his understanding that Shock rapids were named after Dr. Shock, who is now dead. When the raft was stuck on the rocks there he got off, the water was only knee deep, and he walked from the raft to the left-hand bank of the stream, or the right-hand bank going down. (R. 3157.) He didn't attempt to wade the stream on the other side

of the raft, it was too deep, he would judge, and the waves were too big. There was no deeper water; he knows the river pretty thoroughly there; he knew they were in the deep water. (R. 3156.)

The top of the rock where the raft stuck was probably buried under the water seven or eight inches and the water to the sides of the rock was about knee deep. The rock was a point of bedrock sticking up, not an individual rock. There was possibly twenty-four hundred pounds on the raft at that time. The trip started in the afternoon and they camped as soon as it got dark, about seven or seven-thirty o'clock. (R. 3157.) Trip was made in October. (R. 3157–3158.)

The place he went to was ten or eleven miles above his camp at Rincon and Shock rapids are about six to eight miles, possibly, above.

The raft was got to camp the next day from the time they left the first place it was stuck. They arrived at camp right after the noon hour, unloaded all the equipment, then tried to avoid all possible chance of losing any equipment coming down stream. (R. 3159.)

Of the two bits taken in the row boat one would weigh about one hundred pounds and the other about one hundred and twenty-five pounds. Besides the bits they had their bedding and camp equipment in the boat.

He has no recollection of going over these matters with Mr. Collins. (R. 3160.) He did, however, talk with Mr. Ryan concerning the ledge but did not have much of a discussion; it was mentioned.

Q. Well, anyway, regardless of what may have been the subject-matter of your conversation with Mr. Ryan, you desire to state on the occasion referred to by you on your direct examination that you walked clear across the river, one side to the other?

A. Where there was water, yes.

Q. You don't call anything a river that has no water, do you?

A. I have seen those things called rivers I didn't see no water in.

Q. Pay attention to my question, Mr. Bennett. You wish to be understood as saying, do you, that you got out, got in the river, walked clear from one side of the river to the other for the purpose of finding out just what the depth was from one side to the other?

A. Yes; and on account of my own curiosity as to the depth of it. (R. 3163–3164.)

The river at that point was about three hundred and fifty or four hundred feet wide during the low water and this trip was in November of 1920. He took no notice as to the location of that portion of the river where the river was two feet deep. (R. 3164.)

The two feet of water was on the right-hand side going down. There were several channels at that

place and he walked through all of them. The deepest one was on the right-hand side of the river and it was two feet deep. That channel was probably six feet wide, the stream was divided by an island and the channel he found was on the right-hand side of the island going down. The portion of the river on the right-hand side of the island was about two-thirds of its total width, or approximately two hundred feet and the two-foot channel was over toward the right-hand bank of this channel going down.

On the occasion when he went up to Hall's Crossing and waded most of the way he did not select the center of the river to wade in but kept where it was possible to wade or where the water was sufficiently shallow. (R. 3166.)

One side of the river in most cases is where you can walk along the side of it; the other side would be the wall rock. He could walk up the side without wading the river, but I would have had to get out in it deep enough to float the boat; maybe places where there was very few inches of water, only two or three. (R. 3167.) A very little part of the distance was rowed. (R. 3167.)

Redirect examination (R. Vol. 17, p. 3168):

There is big rocks on the left bank of the river at Lake Canyon rapids along the wall rock, big rocks has fallen in there; it causes big waves in there. It was necessary in the operation of this

raft to avoid that, because he didn't want to get in there and lose the material that was on it. (R. 3168.)

Further examination (R. Vol. 17, pp. 3168-3170):

During the work at the oil camp there were four or five men there in 1920. Supplies were brought in from Torry to Hall's Crossing and to the Baker Ranch and down by packs or by boat. Supplies were brought in only when they went up the river on the occasions spoken of and on two of those occasions there were no supplies brought in. (R. 3169.) Did not go to Hall's Crossing especially for supplies. Supplies came down the river from Hall's Crossing by boat twice. (R. 3170.)

[illegible]

[illegible]

[illegible]

Resides at Lund, Utah; 66 years old; superintendent of mining property. (R. 3171.)

He is familiar with Colorado River; first went on river at Hite, Utah, about December 1, 1[illegible]. Went from Hermosa mine in Henry Mountains with pack mules and saddle horses; went down Trachyte Canyon to Hite. (R. 3172.) Had Mr. Sumner with him.

First trip down to Good Hope Bar was made with horses and mules; trail follows river on left bank part way. (R. 3173.) came up to Tickaboo

bar with animals on wagon road built between Good Hope and Tickaboo Bars. Remained with Good Hope Mining Co. until January, 1898; went back to Good Hope Bar overland and remained until July or August, 1898. (R. 3174–3175.)

Supplies brought in from Hite with a wagon; and boated down Colorado River. Boats were flat bottom, 22 to 24 ft. long, 4 to 5 ft. beam.

Went downstream on Colorado River 18 miles to California bar. (R. 3175–3176.)

Went out by team to Richfield, Utah; over poor road up Hanson Creek, then to Salt Lake City. Came back in fifteen days, took his supplies to California bar; that is just across the river from Hanson Creek. (R. 3177.) Forded river with the wagon; this was latter part of November or first of December, 1898; not necessary then to swim horses; river shallow at that point. (R. 3178.) River had gravel bottom; had forded with a horse before by following a bar around. Worked on this bar four or five years. (R. 3179.) Supplies brought in with them from Hanson Creek; boated across river. Afterwards where river was forded, channel washed a little deeper and could not ford it. (R. 3178.)

He had two boats on Colorado River; one 28 ft. long used to haul coal across river; one light skiff used to cross river. Purchased interest in bar from Mike Ryan; from Timothy O'Keefe he bought Olympia bar, 4 miles above. (R. 3174–3175.)

Went upstream to Hite to get mail about once a month; by boat if river conditions favorable; other times walked up; sometimes could sail part way, walk balance. (R. 3180–3181.) Towing outside of wind considered easiest way of getting up river; easier than rowing. (R. 3182.)

First motor boat tried on river was about 1902; built at Hite of white cedar; 26 ft. long, 6 ft. beam; flat bottom; equipped with automobile engine; double cylinder; tried to use it going up river, never got it any farther than Good Hope Bar, about 14 miles; could not run up Good Hope rapids with it; did not have enough power to go over; eventually sprocket chain broke, it went into river and he lost it.

Good Hope rapids are 18 miles below Hite; tried both stern and side wheels on boat. (R. 3182–3183.) Side wheel, on account of swift water one side caught on rocks, other side out in swift water; could not hold boat; one side outrun the other. (R. 3183–3184.)

He next operated a motor boat in 1905 or 1906; propellor boat bought from Mr. Yokey at Greenriver; hauled overland by way of Hanksville; down North Wash to Colorado River; used to run up and down river; supplies would be brought to Hite and run boat from Olympia bar up to Good Hope bar and load with supplies (R. 3143–3185); went to Hite by towing boat. (R. 3185.) Boat was 22 ft. long and 4 ft. wide; it had 12 H. P. engine in it,

draft was 8 inches; propellor 16 inches, would strike on rocks. Boat sunk at Tickaboo. Left it at Tickaboo during high water; water went down left it out dry; it filled again and slid into 15 ft. of water and filled with mud. Took engine out. (R. 3185, R. 3186.)

Built a motor boat at Greenriver; bottom rounded out; built like a tunnel to guard propeller from rocks; half of screw worked in tunnel; 24 ft. long.; stern had a draft of 16 inches; equipped with engine from boat sunk. Loaded on truck; took it overland to mouth of North Wash on Colorado River by way of Hanksville. (R. 3187–3188.)

He did want to risk his life taking it down river from Greenriver, Utah.

Boat did not do very well; too much back draft; water followed back upstream; it would sit down in water and drew the water along behind it; took engine out and used boat as a sail boat; used oars on it; at certain stages of water sailed over rapids; 4 ft. above low-water mark was good stage of water (R. 3188–3189); last motor boat he used except 14 ft. skiff with outboard motor (R. 3189). It did not have power enough to run swift water; the muddy water burned bronze wheel bearings out. (R. 3189.)

He was on Colorado River during part of every year from 1897 to 1920. (R. 3190.) Has been down Colorado as far as Lees Ferry; went down latter part of December, 1898; left Lees Ferry January, 1899.

Remembers when Mr. Hite, Timothy O'Keefe, and a man named Gillan, in 1898, had trouble in river with ice; ice gorge piled up; water was swift; boats could not go any farther; towed the boat with a line and got them to shore; tied boat until ice gorge went out. (R. 3191–3192.) Boat was loaded with supplies. (R. 3193.)

Ice gorges go clear across river; backs river up. (R. 3194.) Ice gorges generally occur in January and February. (R. 3195.)

Compl. Exh. 62, page 13, shows river freezing over. (R. 3195.) Supplies on Hite's boat taken down road between Tickaboo and Good Hope Bars after unloading from boat. (R. 3195.)

Recalls fording the Colorado River with Mr. Ryan in 1898 above mouth of Hanson Creek. (R. 3196.)

In December, 1898, went to Lees Ferry with Mr. Stanton, John Hite, Mike Ryan, and Jack Uton. (R. 3197.) Helped bring Stanton's boat up river. (R. 3196.)

Went downstream in flat-bottomed boat; also had a lifeboat. (R. 3197.)

Between Good Hope and Mouth of Warm Creek are a number of rapids; rapids right where they started from. At mouth of Pine Alcove Creek, Bull Frog, a heavy rapids. (R. 3197–3198.) Lifeboat struck going through Bull Frog Rapids.

There are two places in the Colorado River where a ledge runs across the river. (R. 3198–3199.)

At Shock Bar, the lifeboat was in difficulty; waded back and forth; found cracks in the bed rock, deep but not wide. (R. 3199.) Four of them helped boat over these. (R. 3199.)

There is quite a reef farther on down the river. (R. 3200.)

Came upstream with Stanton boats; took about 3 weeks to make trip; there were 12 or 13 men; had a launch, two lifeboats, and two flat-bottom boats; delivered at dredge just above Bull Frog Rapids; motor boat did not come up under power. Rowed, towed, waded in river, man on each end of boat; hard work getting boats up the river. (R. 3201.) Current is heavy at Aztec Rapids. (R. 3202.)

Mr. Stanton located placer claims all way from up above Hite to Lees Ferry; some crossed the river. (R. 3201–3202.)

Brought boat over Aztec Rapids with block and tackle. (R. 3202–3203.)

Sand waves on Colorado are not so bad in winter as sand moves all the time; worse when river begins to rise in March and April; river begins to go down, sand accumulates about latter part of August; can hear them boiling when river is raising or falling during high water. (R. 3204.) They break upstream; they get 8 ft. high; seen them between the rapids; worse below mouth of San Juan. (R. 3204–3205.)

Going upstream, intermediate water most acceptable, 4 or 5 ft. above extreme low water; in high water, water runs out; can't get up against the current; in low water, too many shallow places; rocks stick up in river; sometimes buried; run on them and cannot get off; water is on both sides. (R. 3205–3206.)

Going down river in 1901 with lumber from Hite to Olympia bar, 25 miles; lumber was hauled to Hite with teams; made three rafts with the lumber; rafts 14 ft. square; cabled together; loaded on gasoline 20 H. P. engine; fly wheels weight 2,500 pounds; complete engine 5,000 pounds; some supplies and eight men; went down during high water in June, not extremely high, but with water 12 or 14 ft. above low water. (R. 3206–3207.)

Had big waves at Trachyte Rapids; got in big whirl at raceway at Good Hope Bar; touched rocks. (R. 3207–3208.) Eventually got through and landed at Olympia bar. (R. 3208–3209.)

Supplies came down Hanson Creek and up river 5 miles to Olympia Bar; once in a while brought them by boat from Hite; first by railroad to Greenriver and by team to Hanson Creek.

During all the time he was there never received supplies from Greenriver, Utah, by using boat on river. (R. 3209–3210.)

Oil rig brought down stream in November or December to Good Hope bar from California Bar on a raft he built; he also used a boat; oil rig he used to drill to sample rock and it weighed 3 or 4

tons; it was dismantled and taken back upstream to Olympia bar; made three trips; made two trips from Olympia bar upstream. (R. 3211.) It is 15 miles from California Bar to Good Hope Bar.

Copper was mined about 9 miles from Hite, up White Canyon; took ore out on teams to Green-river. It was carried across river in funnel boat. (R. 3213.)

Colorado River Channel shifts from time to time; during high water or immediately after; obstruction causes current to run over and bore under it; shift ¼ or ½ the distance of river. (R. 3218.) Knows of two or three islands that had timber on them which disappeared. (R. 3219.) River works fast cutting banks out. (R. 3219.) Current causes whirls.

Going downstream, can not always find channel in same place; changes from one side of river to the other. (R. 3219.) He has known changes to occur between trips. (R. 3219–3220.)

He has been on San Juan River in neighborhood of Bluff; been at mouth of San Juan and upstream about 12 miles; went down 12 miles from Bluff to Bartlett Station by pack outfit. River at Barrett Station, quite a little stream of water, but small; he went up river bed, no real water there, just lay in pools. This was in October, 1900. (R. 3220–3221.)

Went back to Hite with pack outfit, over old wagon road. Old Mormon trail. From Hite took a boat and went to mouth of San Juan River; and

up San Juan about 12 miles. (R. 3222.) Started to row up, too much sand, too many bars; waded down river taking boat with them; drifted back down that night. (R. 3222–3223.) This was about 15th of October. (R. 3224.)

Made one trip on Green River with Captain Yokey; went from Greenriver on boat called *Cliff Dweller;* ran a little way down, ran aground. He did not stay with the boat. Mr. Oppenheimer ran the boat. (R. 3224–3225.)

Cross-examination (R. Vol. 17, pp. 3226–3239).

Cass Hite's brother, Col. Hite and Companions coming from Hite were caught in ice jam; when jam broke, they took boat on down the river. (R. 3227.)

He made a number of short and long trips on river, crossing and hauling wood across; made great many trips up and down; during those years did not see many other people making similar trips; in year and half did not see any one pass his place; not a great deal of traffic on river. (R. 3227–3228.)

He did not always reach his destination by river; good many times tried to get a boat upstream, but on account of conditions he could not; has carried stuff five miles across by trail when it would have been nearer with boat; used his best efforts and was not able to get up.

On one trip water very high; three men with him; worked nearly two days but could not get up a certain point; was going to Hite from Olympia

Bar. (R. 3230–3231.) Had to climb over rocks; trail was under water. (R. 3231.)

Copper mining in White Canyon; copper bedded in flat veins in sandstone; shipped a number of cars; freight rates too high, had to quit. Sacked ore, sledded downhill, along fair wagon road to point on left bank of river; then across river in rowboat; used four men going across when water high; loaded it in wagons and hauled it to Greenriver. (R. 3233.)

Colorado River has shifting bed, and changing of channels occurred during high-water season; after river settled down to low or normal water, very little change. (R. 3223.) Sometimes other floods would have nearly same effect as spring high water. (R. 3266.)

The ice gorges he has seen on the river generally last for several days, and as a general thing will break in twenty-four to forty-eight hours, and he believes the longest time he knew of one to last would be about a week. (R. 3236.)

In the sandstone ledge that he encountered twice near the Shock Rapids, there are narrow breaks or cracks in the rock. He does not know how far they extend up the river. He went across and took an oar to follow them along, and would find an open space and step across, but he did not know whether they continued on up or down the river, but the cracks were narrow, so that he could step across, and some of them would be full of gravel.

If you did not have something to know where you were stepping, you might step right in. An oar would go down four or five feet in some places. These cracks would be two or three feet wide. (R. 3237–3238.) At this point the entire river spreads out and he could not find any regular channel through there, and outside of the deep places in these cracks he did not believe that the water was over two feet deep. The river at this point might possibly be 500 feet wide, and after he got out forty or fifty feet from either shore he did not find much difference in the water, wading across and shoving the boat, and trying to work it over. (R. 3238–3239.) He found very little difference outside of the places that he could put an oar down its full length, and he kept working the boat further down, shoving it along on its keel. The water was very low. (R. 3239.)

Redirect examination (R. Vol. 17, pp. 3239–3240):

During the time he was on the Colorado River the floods would occur in the latter part of July or August. This was outside of the spring rise. Most of these floods would be local from cloudbursts in the mountains. Three or four of them came from the San Rafael, and you could generally tell by the color of the water where they came from. The storms would sometimes extend until September or October, and after the storms there would sometimes be a rearrangement or change of the sand bars. At other times there would not. The

upper part of the river is principally gravel and the bank does not change much, but the channel below does. The particular part of the river that he was working on was more gravel, and when he was drilling they went through gravel nearly all the time, and the holes ranged from twelve to forty feet to bedrock. (R. 3239–3240.)

Further examination (R. Vol. 17, pp. 3240–3241):

During the period of twenty-two years that he has been on the river he believes that in 1898 the greatest number of men were working in the stretch between Hite and the California Bar. This was when Mr. Stanton was building his dredge, and building roads and so on, and he believes there were in the neighborhood of 75 or 100 men in the river at that time. Most of them were living in tents. The Stanton Company did not bring in any supplies except for their own outfit, and the majority of the men were working for the Stanton Company. Since 1898, for a long while there were twelve men there that got mail from the Post Office, and some of them lived in little houses, dugouts, and some in tents. They made houses out of willows and plastered them.

WILLIAM R. NEWBY

For Complainant

(Record, vol. 17, pp. 3242–3261)

Resides at Greenriver, Utah; occupation, farmer. (R. 3242.)

Made a trip on the *Cliff Dweller* in August, 1907, as a roustabout, or boatman. Knew it when it was called the *City of Moab*. Fair stage of water leaving Greenriver. (R. 3242–3243.) Made good progress down stream until they hit something and so many hits hard to tell just exactly where the first one occurred; but it was above the mouth of the San Rafael; and that was the story from Greenriver to the point 105 miles down at Valentine's Bottom—hit and miss. (R. 3243–3244.)

Took soundings with a pole; carried lines ashore to get off sand bars, and used capstan. (R. 3244–3245.)

When he took the pipe pole he would sit on the bow, keep working the pole, touching bottom, and as the bottom got further away, of course, the pole would go deeper; as he found the bottom more shallow, keep raising the pole up, hitting the bottom every time, you understand. After while it would be almost to the top of the water. (R. 3245–3246.)

Depth varied so frequently had to take almost continuous soundings. (R. 3245–3246.)

Noticed the water was falling and this evidently had something to do with turning around and coming back. Had more difficulties going back than coming down. Encountered sand bars on through old Fort Bottom, the Narrows, and Nigger Bill riffle. Finally made Wolverton ranch and tied there about a week. Made changes in machinery of the

boat and tried to raise paddle wheel above the bottom of boat so it wouldn't hit the rocks. (R. 3246–3247.) Does not believe draft of boat over 18 inches. (R. 3248.)

They finally got the boat back in to Greenriver, Utah. On this trip they didn't carry any passengers, just the crew, it was an experimental trip, and the boat was sold, he believes, to some firm in Salt Lake City, and he don't believe it ever made any more trips. (R. 3248–3249.)

(Attention called to Exhibit 94, showing discharge of Green River in August, 1907, the lowest water was seventy-one hundred second feet, and the highest nineteen thousand three hundred, and the mean eleven thousand two hundred.) (R. 3249.)

The witness knows Tom Wimmer, but he didn't know the boat *Marguerite* or the *Betsy Ann*.

He was last near the river at Greenriver, Utah, the day he was subpenaed, about October 4, 1929, and there were no boats that he knew of tied up at Greenriver. (R. 3250.)

On this trip with the *Cliff Dweller*, on his up trip after he left Wimmer's ranch, had difficulty at Brown's riffle; there is a little island right there below this riffle they call Goat island; you can take your choice of the sides of the island for a channel, which they did. They took our choice, and they stuck fast on the gravel, and they were stuck good and hard on coarse gravel rock that would weigh

fifteen or twenty pounds, some of them, and there was no chance for them to get the boat off by hand, so Tom and he got in a skiff and started to take a line ashore, and the water was quite swift over this riffle, and they didn't have depth enough to manipulate the oars on the skiff, and they kept getting downstream further, so finally he just hit overboard and grabbed the line and waded ashore. Tom, he stayed with the boat, and kept getting him downstream further; he seen he couldn't make it, so he got out, and led the boat back up to the *Cliff Dweller* and made fast. He finally got the rope around a post or an old stump that grew on the river bank there, and they got the line made fast, then started the capstan on the boat. They finally wound ourselves over, and then they started the boat on her own power, and finally made Greenriver. (R. 3250–3251.)

He recalls the boat known as the *Black Eagle,* but don't believe it was half as big as the *Cliff Dweller.* It was equipped with steam power and was launched just above the railroad bridge at Greenriver, Utah. (R. 3251–3252.) Would not call it a trip he made on the *Black Eagle,* but he fired the boiler while they crossed the river—that is, crossed it angling upstream—probably made a half-mile on the boat. (R. 3252.)

This was above the Greenriver bridge, and the boat was just tied up to the shore, and he don't know what Mr. Yokey did with it after that. As

far as he knows, this was the first trip of the *Black Eagle,* and it must have been about 1908 or 1909. (R. 3252.)

The last time he saw the *Black Eagle* it was tied up where it was left on that trip. (R. 3252–3253.) As far as he knows it disappeared from Greenriver; didn't see it anymore. In those days went down river once a year. (R. 3253.)

He made a trip on a boat called the *Wilmont,* that belonged to E. T. Wolverton. It was side-wheeler, gasoline boat. This trip was made in the fall of the year, probably the latter part of September, 1909. This was a pleasure trip to hunt deer.

He overtook the boat [Wilmont] at the narrows about 60 miles from Greenriver. He had gone down in another gasoline boat, called the *Dispatch,* that belonged to J. S. Ladd. (R. 3253–3254.)

Going down river in party were J. S. Ladd, Gus Kettole (he was a Finnish man), Charlie Twitchell, Harry Wood, and myself. (R. 3254.)

This party started out from Greenriver in the *Dispatch* boat and intended to make Wolverton's ranch to camp the first night out, but got stuck about a mile before they got there. Mr. Kettole and the witness had to get out, and they went to shore and made camp. Starting out the next morning, had no more difficulties until he overtook Mr. Wolverton at the Narrows, where they stayed all night.

The next morning they left in Mr. Wolverton's skiff and he [Wolverton] went with them around Bowknot bend. There were three in the boat; the balance of the party on shore went around on foot.

They went around the Bowknot bend and came back to the Narrows that same night and made camp, and the next morning started upstream in the *Dispatch* and the skiff Mr. Wolverton had with him and went to where Wolverton had the *Wilmont* tied up, and proceeded upstream with the two boats. (R. 3254–3255.)

They proceeded upstream with the two boats, and they encountered a few sand and gravel bars until they got up to Mr. Wolverton's ranch again. (R. 3255.)

Mr. Wolverton decided to go up to Greenriver with them, and they took the *Wilmont* and the *Dispatch* boat also and made Greenriver in one day. (R. 3255.) With the usual difficulties they had with sand bars and gravel bars, and the Brown riffle at that time was so they made it all right without grounding there. (R. 3255–3256.)

He made another trip on the *Dispatch* from Greenriver to Little Valley about five miles below the Greenriver bridge, but there was no difference between that and the first trip with reference to sand bars.

The *Dispatch* broke loose one night at high water and it wrapped itself around one of the piers at the bridge and was destroyed. (R. 3256.)

The *Dispatch* was a gasoline-propelled boat, and the *Wilmont* was a side-wheeler, also gasoline propelled. (R. 3256.)

Mrs. Newby was with him on the Little Valley trip.

He recalls the boat known as *Slapping Sal*. It belonged to H. T. Yokey. This was a four-oared rowboat. (R. 3257.)

This boat didn't have any power on it and would draw 6 or 8 inches. He got stuck with this boat at Little Valley taking a drum of gasoline down to Wolverton's ranch. Struck a flat rock out in the river and stuck there. Had quite a time getting loose, but finally made it and went on down all right. Yokey was not on this trip, but he has made trips with Yokey. (R. 3257.)

He went down with Yokey on the *Slapping Sal* to Tenmile bottom; that is about 42 miles below the Greenriver bridge. He had difficulty on that trip and had to abandon the boat about a mile below Tenmile bottom, and they had to climb out of the canyon and come up overland on foot. This was in December. (R. 3258.)

He don't believe he has seen this boat [the *Slapping Sal*] since that trip. (R. 3259.)

Between the years 1905 and 1928 he has noticed changes in the course of the river and changes in the channel conditions of the Green river at Greenriver, Utah.

At the old Trap ford just about half a mile north of his place the river has changed about two

hundred yards from its original place. The Trap ford is a place they used to ford the river; they called it the Trap ford, after the man that used to live there, and this ford was very rough and rocky. There were large rocks in the bottom all the way across, and those rocks are all gone; the riffle is way down below, probably two hundred yards below where we used to cross with teams. He does not know how deep the water is at the original old ford. There is a complete change there that I know of. (R. 3259–3260.)

Another place he knows of where the river changed recently a year ago when it took out four acres of land and the whole river moved almost six hundred feet westerly, and also at Salaratus wash that when he first went there in 1905 was a small wash probably fifty or sixty feet wide and at the present time it must be two hundred yards wide.

During the time he has been at Greenriver he does not know of any merchandise of any kind ever having been shipped in to Greenriver on the Green River. (R. 3260–3261.)

No cross-examination.

MOLLY NEWBY

For Complainant

(Record, vol. 17, pp. 3261–3264)

The witness was born at Leavenworth, Kansas, and is the wife of William R. Newby who has just testified.

She came to Utah in 1900 and has made one trip down the Green River on the boat named *Dispatch*.

She heard her husband detail the trip of the *Dispatch* boat and it corresponds with her recollection.

She never saw the *Black Eagle* boat nor the *Wilmont* boat. (R. 3261–3262.)

She has been near the Green River at Greenriver, Utah, about two weeks ago, and she sees it there quite often from time to time, and there are no boats at Greenriver now that she knows of, and she does not know of any of the merchants in and about Greenriver getting any supplies which are shipped in by boat on the Green River. (R. 3263.)

No cross-examination.

L. M. CHAFFIN

For Complainant

(Record, vol. 17, pp. 3264–3295, vol. 18, pp. 3298–3337)

Full name is Louis M. Chaffin; 56 years old; lived Greenriver past 10 years. Has followed prim-ing and stock raising.

Has been on the Colorado River from the junction of the Green and Colorado down to Lees Ferry. (R. 3264–3265.)

In 1888 or 1889 took a load of lumber from Loa down what is called Hall's Creek, across into Hanson Creek, and down Hanson Creek to the mouth of Smith's bar. (R. 3266.) Lumber was driven across the river and horses did not have to swim.

This was in the latter part of August or first of September. A 60-H. P. boiler was also taken down on this trip. (R. 3267.)

Went to prospecting on the Colorado River in 1892 with Ed Meskin. (R. 3268.) Took a team, wagon, and supplies; followed the same route. Built a small skiff and went up the river to Hite. This was in September. They poled and towed and rowed the boat up the river. Waded and pulled it over the bad places. (R. 3270.)

Remained until spring of 1893. Made one trip with team for supplies. No settlers at Hanson Creek. (R. 3270–3271.)

There were places at the bar called the Little Anna where the water carried a great deal of silt, and it would settle and they would get on these mud bars; had a light boat and encountered little trouble. (R. 3230–3231.)

In latter part of 1892 and early in 1893 there were some people operating at Hall's Crossing and an outfit below Hite, and some men at Tickaboo and Good Hope. (R. 3272–3273.)

In August or September, 1894, prospected on the river and took a contract for putting wood and timber on the California bar. Had a team and horses and would go across the river. (R. 3273–3274.)

Made a trip upstream in 1894 and had the same proposition of rowing and towing. When water is still you can row, when you hit rapids you can't

row over them; have to take boat and pull it up, can not pole if you have a big boat. Generally waded over rapids and took the boat up. Wood used for firewood. (R. 3274–3275.)

He stayed in on this trip until sometime in February, 1895, and the two fellows who were with him and himself went into partnership with a man named Bennett and mined up above the California bar along the river. (R. 3275.)

They did most of their work on the upper end of the California bar where in some places the gravel was uncovered, where they could dig in and wheel this out and run it through our sluice box, whatever they had, and save what little gold was there. (R. 3276.)

During the portion of the years 1894 and 1895 when he was in there, the supplies were brought in with teams from Loa. They also got some from Hite in 1895. There was a Post Office there at that time.

The bar he was working in 1895 was 35 or 40 miles below Hite. (R. 3277.)

Trip upstream made by rowing, towing, and poling, and wind and laying off and one thing and another. The time they brought the supplies down was along in May, the first part of May, right about that time, and the river was coming up, and she was pretty hard rowing for a boat. We had a larger boat than we did before. No difficulty.

On other trips he made he had trouble according to the time of year; he has made trips in the fall of the year, take when the floods have been on—take the river after your high water goes down, she leaves a channel, if you find it. Then she will stay, until your floods come in from some side canyon. When they come in, it starts the silt moving, and you can't always go back the same way you went. You think maybe you have got the channel around through here, go around here, jump off somewhere else. When that comes in, it fills up and changes. You have to hunt around to get over and find a place through in those places. For that reason sometimes we got on the bars.

When they start to change, they might change over night on you. That has been his experience; the channel would change over night. Sometimes they would remain where they were for a month pretty well. (R. 3277–3278.)

New Year bar is located down the river about seven miles from Hanson creek. He went there, he believes, in February and worked on the New Year bar until about the first of May, and then went back up the river to Moquie bar, located about a mile and a half below Hanson creek. When he was working the New Year bar he would bring his supplies in to Hanson creek and take them down to the bar in boats and would have the same experience that he had on the other trips, and when he moved to the Moquie bar he would bring his supplies to Hanson creek and take them across the

river in a boat, as the upper end of Moquie bar comes pretty near up to Hanson creek. He believes he left the Moquie bar in June, 1895. (R. 3278–3279.)

Worked on bars in 1895. Operating Moquie bar in January. River very low and shallow and had trouble with small boats in getting over. Waited until river raised to get his stuff down. Had some rafts and boats. Between Bull Frog and Hanson Creek rapids got on rocks with raft. He had two 24-ft. boats. One boat loaded with iron broke, and one boat sunk, but he saved some of the stuff and got the boat out. Had seven boats and the raft. (R. 3282.)

Had to have more supplies and river was so swift he could not get a small boat up. It was high water, and he had teams coming with supplies and was to meet them the 3rd of May; took burros and went to Hall's crossing and built a raft and went to where the supplies were and loaded the raft. (R. 3282–3283.)

At Lake Canyon latter part of August water very low; had quite a time getting raft and stuff over. Had to pry her over with crowbars off rocks to get it over that place. He got in water himself. (R. 3284.)

He found water depth there from nothing to over his head, and the deep places run zig-zag every way, but are not wide enough so could operate boats of kind he was using over there. (R. 3285.)

Could get a small row boat that did not draw over six or eight inches over. (R. 3285–3286.) Lake Canyon rapid is of rock, some are solid and some not, and depth was from 4 to 5 inches. (R. 3286–3287.)

In winter of 1894–1895 there were over 100 prospectors along river from Hite to Hall's Crossing.

In Fall of 1896 or 1897 made a trip to Lees Ferry with Ed Meskin in a small row boat. Water in pretty good shape. Had a lot of sand waves below the San Juan and a lot of places had trouble finding way through with the small boat. (R. 3287–3288.) Bringing boat back upstream, had no serious difficulties, just towed and poled the boat along. (R. 3289–3290.)

Winter of 1898 went down to Klondike Bar. Built two boats. (R. 3290–3291.) Left the boats and supplies and went to Hole-in-the-Rock and expected the boats there. (R. 3291–3292.) River was frozen and full of ice and boats got in ice jam and were lost; saved part of the equipment. (R. 3292–3294.) Afterwards brought supplies to place where they had tipped boats up, and loaded stuff on and took it down through river. (R. 3294–3295.)

At Klondike bar got supplies by way of Escalante across the desert to a water hole on the old Mormon road, and then packed the stuff through the Navajo Valley and down into the Colorado River, and let down from ledges with ropes right on to the Klondike bar. Just small lumber, a few

tools, a couple of scrapers, a plow or two, small things, and food stuff that could be handled on a pack horse. Took stock on to bar by swimming across the river. (R. 3298–3299.)

In 1899 worked on the Stanton Dredge. Supplies came in by way of Hanksville from Greenriver and came to top of ledge about a mile and a half above Bull Frog rapids. Shot a road down the ledge. Had a barge on a cable, with a windlass and would handle drill and machinery up and down the river this way. Never saw barge moved any way but by winding it up, a distance of approximately 1½ miles. (R. 3300–3301.)

They had a gasoline launch and he has seen them try to pull the barge up with the launch, but could not do it. Launch did well to get up itself without pulling barge. Could not pull barge in either high or low water. (R. 3301–3302.)

Was troubled in low water at times on mud and sand bars that would accumulate during changes in stage of water. The river or current changed as water raised or fell. Mush ice runs in February. (R. 3303–3304.)

When he says the current of the creek, he does not mean the side washes, he means the river itself, and when the water conditions change, the current changes as the water raised or fell; for instance, where the dredge was, it was nearly a flat river and the sand bars would accumulate across the river and you would go in and have plenty of water, and you

would go down and couldn't get through and maybe would have to come back and go down on the other side. You would have to feel you way through.

The running mush ice in the river would be along the latter part of February as a rule. (R. 3304.)

The ice condition would begin to end during the latter part of February and when the thaw came it made the changing conditions and the water would commence to rise along the first of March and would be an alternate rising and falling. After you got enough water or after the river raised a foot or so, the effect on the bar didn't bother you any, only to know where to go; after the river raised there was always room to get through if you knew where to find them. (R. 3305.)

From his experience, he believes, that after the river rises in the spring, you could figure on going down the river if you found the right place, as there would be no place, as far as the water was concerned, that you couldn't find a channel through somewhere.

During the months of March and April he would always find changes in the channel every time the water raised or dropped a little, even a few inches, and that every rise or fall of water made a rearrangement of the sand bar. The change would not be in the main channel or in the gravel bars, but in the sand bars in the still water. (R. 3306.)

When the river raised, it made a channel. Where the dredge was built there was still water.

In extreme low water in February, he had to pick around and push a small boat to get over. A boat that would draw a foot of water you couldn't get it over. Then after the river would rise a foot you could always find a place to get by—it might be on the west side of the river to-day, and might be on the east side of the river to-morrow. (R. 3307.)

The same conditions do not prevail where there is a gravel bed as where there is a sand bed, as with the gravel there is a more permanent channel. Where there were gravel beds and the river ran swift, it took a lifetime to make much of a change.

One place where he recalls where he has seen quite a change was where he used to drive across to California bar with the wagon set on the running gears, but to-day you can't go across at all as the channel is washed through there. It has taken a long time to make this change as there is gravel there.

During the months when there would be rain on the river, the rise and fall would wash the silt in and would change the bed of the river in the still-water places worse than at any other time, as far as bad changes are concerned. (R. 3308–3309.)

Rain storms and flood water worse in September. One trip he remembers river rose eleven feet in ten hours. River got so high he could not navigate and effects of this flood lasted about two weeks. (R. 3309–3310.)

Has walked across the Colorado at Shock's bar, and at Lake Canyon, and below the San Juan River. (R. 3310.)

Took some machinery from Tickaboo down the river to Hanson Creek, 18 miles on raft and a boat. (R. 3312.) Machinery was then freighted up Hanson Creek out to Hanksville, a distance of 125 miles, and then out over the desert to Flint, about 70 miles. This is about 8 miles west of the junction with the Green. Did not take it on up the river from Tickaboo, as it was impossible.

He made a trip from Greenriver, Utah, down the Green and Colorado Rivers to some place below the cataracts, he believes, in November, 1904. He had a small sixteen-foot light boat, decked over at both ends, and was accompanied by A. G. Turner, who was operating the California Bar on the Colorado River. They had their bedding a. enough grub to make the trip. (R. 3314.) He don't believe the boat drew over six or eight inches when they first started with their load.

Between Greenriver and the mouth of the San Rafael they didn't have a bit of trouble—only a little rough water. From the mouth of the San Rafael down through he had a lot of trouble finding a channel to get through the mud. There seemed to be no place to go. The water was shallow and the river was spread out, and he could get through by getting off and pulling the boat. He might have found a channel if he had looked, but they would get out and pull over, or if they couldn't would back up and find somewhere he could get through. He got down, but the river was pretty

shallow. (R. 3315.) From the mouth of the San Rafael to pretty near the junction they would get hung up on sand bars off and on.

When he struck the Colorado River he went up as far as Moab and back, and he don't remember having any trouble at all in going up there. (R. 3315–3316.) Left one boat at mouth of Green River; had two boats; took the other boat and went up Colorado. One rowed and the other poled, like ordinarily getting up such streams. They got up and lined her some little. (R. 3316.)

He then returned back down to the mouth of the Green River by water and he don't remember anything occurring, just came along down the creek. (R. 3317.)

When they got back to the junction of the Green they went on down the Colorado River, and going down through Cataract canyon, they never had any serious trouble getting through. The other man's boat tipped over once and he was tipped out. When they would come to a bad place, they would take their stuff out of the boat and would pack it around where they could and let it down with ropes, but generally got in the boat and ran it. (R. 3317.) He remembers portaging around three rapids; that is, carried the stuff around, put the boats over empty. Mr. Turner went through the rapids stern foremost a time or two, but he always went through it the other way. (R. 3318.)

After they got through the Cataracts they did some mining that year on the California, Moquie, and New Year bar.

He first went in to the River in 1888 but didn't commence to prospect until 1892, and was on the river pretty continuously from 1893 to 1908, and then was off and on occasionally until 1911 or 1912. (R. 3319.) Since that time he has only made the one trip actually on the river in 1917, that he has already testified to. He may have been back there a time or two since that and maybe crossed the river, but he was through with the River in 1917 as far as boating was concerned.

During the fifteen years when he was working the placer claims, he brought his gold out to Loa and Richfield through the Richfield Commercial Bank. He would sometimes ship it out with teamsters, but generally brought it out himself.

When he was on the Colorado River in 1917 he didn't see a soul except Mr. Bennett and a fellow named West on the river. (R. 3319–3320–3321.)

As far as he recalls, the winter of 1894–1895 was the biggest year as far as inhabitants were concerned, and in 1898 there might have been a dozen people from Lees Ferry to Hite outside of the men he had working. He also recalls that in 1917 he saw Mr. Lawler or Tom Humphreys at Hite, outside of the ones he has already mentioned. (R. 3321.)

In all the time that he was on the river he never knew of any supplies or machinery having been

brought upstream from Lees Ferry, nor does he recall any supplies having been brought downstream from Moab or Greenriver, Utah. (R. 3321–3322.)

He believes it was in 1896 that he went over to the San Juan River and he went in, he believes, about Cottonwood close to Gable Camp; went over from Hall's crossing with an Indian named Joe Bishop. (R. 3322.)

He don't know the name of any trail he went over, and after he got there he traded his horse for a boat and traded the other horse to an Indian for some blankets. This was close to the first part of December, and went down the San Juan River prospecting, but was pretty much disgusted with it and went down through to the Colorado and back up. He don't know where Cottonwood is located, but it is about 40 or 50 miles up the San Juan River. (R. 3323.) He believes he spent less than a week on the trip and there was water enough so he could get down through, and there were a lot of sand-waving shallow places. It wasn't good going with the boat he had, and he was stuck a time or two on sandbars. After he got down to the Colorado River he went up the Colorado to Hanson creek, and this was his first and last experience on the San Juan River, and he didn't take out any gold. (R. 3324.)

The first sand waves that he remembers noticing on the Colorado River was in the winter of 1898, when he went down to the Klondike bar, and they

were right below where the San Juan comes in. (R. 3325.)

Cross-examination (R. Vol. 18, pp. 3325-3337):

The lowest stage on the Colorado and the San Juan Rivers, he believes, is in February, and they are at a very low stage in December, and the water is at the lowest stage during the months of December, January, and February. (R. 3325.)

On his trip from Greenriver, Utah, down the Green River to the mouth of the San Rafael, he had no trouble, but from the mouth of the San Rafael down to the junction, he encountered sand bars. He encountered more obstructions of that character in the stage of the Green River from the San Rafael down to the mouth than he encountered between the foot of the Cataract Canyon and the Utah-Arizona state line. (R. 3326.)

He would say the difficulties of navigation are very much greater on the Green River from the San Rafael down to the mouth of the Green River than on the stretch of the river between the foot of Cataract Canyon and the Utah-Arizona State line as far as shallow water and sand bars are concerned, and so far as making progress in boats, and interruptions of travel going downstream. Never been upstream, except on part of it. The water runs so slow it would make very little difference whether you went up or down on the Green River. On the Colorado it would make a lot of difference.

on account of swift water. It is harder work going up the Colorado. (R. 3326–3327.)

He would say as far as sand bars are concerned that there were more mud and sand bars from the mouth of the Green to the mouth of the San Rafael than there are on the Colorado, but for rocks and getting the boats up and the currents, the Colorado River, every mile of it, has got the Green River beat the whole distance of her. (R. 3328.)

"Q. From your experience on those stretches of the two rivers that I have indicated, would you not say that the difficulties of navigating upstream are greater on the Green than on the lower Colorado, with the single exception of the matter of power required to cause the boat to go upstream?

A. If I had unlimited power, I would say yes.

Q. Then it is merely the matter of power, isn't it?

A. You can shoot a bullet up her. (R. 3331.)

After he rescued the supplies when the boats were in the ice gorge, he took them on down to the Klondike bar. At the time he had one boat and one small rowboat and he accompanied them as far as Hole-in-the-Rock, and later he saw the two boats and unloaded them at the Klondike bar. He remained at the Klondike bar for about a year off and on, and he had maybe four or five boats. (R. 3331–3332.) When he quit working on the Klondike bar he didn't go upstream with the boat, and when he returned he went to the Klondike bar again and used the boats he had left there.

He don't remember just how long he stayed there, it might have been 2 or 3 months, and when he left he went up the river by Tickaboo and Hite, went out around by Richfield. He didn't take his boats and supplies with him, but went around and came down with new boats. (R. 3333–3334.)

During his work on the Colorado River, while he don't consider it has anything to do with the question, he says that he took out twenty thousand dollars worth of gold, more or less. (R. 3334–3335.)

Altogether, he believes he has used and operated fifty boats.

It is generally true that the changes that occur in the channel of the river occur while the river is rising and settling. (R. 3335.)

The torrential rains in September may cause a sudden change at certain points, and it is his experience that after the water started to rise there was a channel if you knew where to find it, and unless the river would rise or fall, it would stay pretty much like it was after the high water was over, and if it didn't, it would change from one side to the other. (R. 3336–3337.)

Redirect examination (R., Vol. 18, pp. 3337):

He has a ranch about a mile and a half from the Green River at the mouth of the San Rafael and he gets his supplies from Greenriver, Utah, but he doesn't use boats.

He was in Greenriver about a month ago, and believes he noticed a rowboat there.

He believes it was this summer that he saw a rowboat tied there above the bridge. (R. 3337.)

Recalled (R., Vol. 18, pp. 3360–3363):

In 1896 on San Juan River at Gable camp, Zahn's camp the nearest place to it. Notes depth of water by testing with oars; lots of places where water was not over a foot deep in channel; probably less in places. (R. 3361–3362.)

Traded pack train for blankets and a little boat. (R. 3364.)

LEVI KENDRICK

For Complainant

(Record, vol. 18, pp. 3338–3342)

Has resided at Greenriver since 1910. Is a well driller. Only boating on the Green River has been for pleasure. (R. 3338.)

No boats he knows of at Greenriver at the present time. Recalls the *Marguerite,* and it is sunk in the mud at the present time at Greenriver. Knows of no merchants or inhabitants ever getting supplies by way of boat on the Green River, excepting Mr. Wolverton. (R. 3340–3341.)

Supplies for well of Monumental Oil Company on the San Juan River and equipment for drilling were brought in by team. Taken across the river by teams. (R. 3341–3342.)

MAUDE KENDRICK

For Complainant

(Record, vol. 18, pp. 3343–3349)

Lived at Greenriver since 1905. Crossed the Green River on horseback at Old Trap Ford in 1910. (R. 3343.)

Recalls boat called *Dispatch* and knows that it broke loose and sunk. Also saw boat *Marguerite* filled with sand at the bridge at Greenriver. Was on boat *Cliff Dweller* about a mile and a half below the bridge on a pleasure trip. (R. 3344–3345.)

Made a trip overland from Greenriver to Wolverton's ranch and went down the river to Three Forks Canyon and came back to Little Valley; Mr. Wolverton decided he could not go over the rapids on the Green River at Little Valley, tied up the boat, and had them taken back by wagon and team. (R. 3345.) Boat stopped before it got to the Auger Riffle. Did not go downstream in the motor boat but in a rowboat; next day started upstream in a motor boat. Went down stream about 5 miles and came back in motor boat to within six or seven miles of Greenriver. (R. 3347.)

Cross examination (R., Vol. 18, pp. 3347–3349):

When crossing the river, water came approximately to the stirrups. (R. 3349.) Only occasion she ever forded the river. (R. 3348.)

HUGH H. HYDE

For Complainant

(Record, vol. 18, pp. 3350-3359)

Born in Monticello, Utah, in 1900. Cable splicer for Am. Tel. & Tel. Co. Spent a good deal of time on San Juan River, principally at Bluff. (R. 3350.) Depth of water varies in different seasons of the year, when it was high, would never attempt to swim in it. Summer time river real low. (R. 3351.) Has driven a bunch of sheep across the river at Cottonwood Wash. (R. 3352.)

In 1916 water on San Juan River was very low, went down to irrigate an alfalfa field, and looked up the canyon and saw a wall of water five or six feet perpendicular rolling down with trees and everything like that in front of it; water hit the bank and went up over it. (R. 3352-3353.)

July and August seasons of rain storms; fall rains more quiet. Rapid rises occur in river and has seen it rise four or five feet in half an hour during July and August. (R. 3353.)

San Juan River carries good deal of sand and sediment and in summer flood seasons this is the heaviest, carries more than during the spring ruff off. Floods do not last as long then. (R. 3353-3354.)

Has seen sand waves; form where river has a straight run of two or three hundred yards; waves run high until they hit the bank. (R. 3354.)

Has walked across the river at Bluff a half a dozen times. (R. 3356.) During July and August. Have skating every year generally. (R. 3357.)

Was with the Trimble party on the San Juan River in 1921 as a rodman. So many rapids between Bluff and the mouth of the San Juan hard to estimate the number. (R. 3358.)

Photograph at camp; water raised several times; so muddy fish swam to the edge of river and killed them with sticks. (R. 3359.)

Cross-examination (R. Vol. 18, pp. 3358–3359):

He recalls that some of the party went down to the mouth of the San Juan River and returned with some supplies, and while he knows a Mr. Christensen, who was with the Trimble party, he does not know whether it was Mr. Christensen or somebody else who brought the supplies back from the Colorado River. (R. 3358.)

The party was located about 6 miles from the mouth of the river when this trip was made, and he knows that Mr. Loper was a boatman at that time. (R. 3359.)

Redirect examination (R. Vol. 18, R. pp. 3359):

They were camped down there at place shown photo B, plate 19, Compl. Exh. 56; the water raised several times; it got so muddy the fish swam to the edge of the river; they were killing them with sticks. (R. 3359.)

He has not seen fish in this condition at any other time on the San Juan River. (R. 3359.)

ELLIOTT BIRD

For Complainant

(Record, vol. 18, pp. 3370–3384)

Resides at Springville, Utah. Was working as a surveyor in and about Warm Creek, during September, October, November, and December of 1917. Supplies came from Kanab, Panguitch, and Marysvale by team and wagon. (R. 3370–3371.)

In and around Hall's Crossing on the Colorado in 1923. Supplies from Escalante and Loa by pack train to Hall's Crossing. Never received any supplies by river.

Hanksville a town of ten or twelve families. No other town between Hanksville and Colorado River. Saw no boats on Colorado River, or other people outside of his own party while working at Hall's Crossing. (R. 3372.)

No one living at Paria. No towns in country south and east of Hanksville; three or four different people live in there. (R. 3373.)

Has been on Colorado River from Moab to about ten miles below Shafter Well No. 2. (R. 3373.) Used a rowboat 18-ft. equipped with outboard motor for crossing river and reaching certain points in connection with the survey. (R. 3374.) Motor failed, unable to row boat upstream, and

dragged it with a rope until they reached a bluff, then crossed and dragged it up on other side. This was about December 19, 1926. (R. 3374–3375.)

Trip downstream in Moab Garage barge operated by Virgil Baldwin to Well No. 2. Took a day and a half going back upstream. Had difficulty with sand bars. (R. 3375–3376.) Line taken ashore to drag boat off bar, dragged about 150 ft. upstream at a point ten miles below Moab. (R. 3378.) Another point was 15 or 16 miles below Moab, had to drag boat upstream about 50 ft. (R. 3379.)

On trip from No. 1 Well up to Moab they were held up four or five times in the forenoon. (R. 3381.) Took line out after they had gone upstream about 10 miles. Trip made about 19th of December, 1926. (R. 3382–3384.)

Cross-examination (R. Vol. 18, pp. 3378–3384):

The point where the boat had to be dragged 150 feet upstream was approximately 10 miles below the town of Moab. (R. 3378.) Another point was about 15 or 16 miles below the town of Moab, where they had to drag the boat upstream about 50 feet. (R. 3379.)

On these occasions he believes the cable was taken out in a row boat. He recalls that the first time the boat was held up about an hour and on the third occasion about two hours. On the second occasion they were held up about an hour and

a half. This was on the trip upstream from No. 2 Well to Moab. (R. 3379.)

They left No. 2 Well about one o'clock and that day went to Shafer Well No. 1 and were hung up between the two wells about twice, the first time about 45 minutes and the second time he believes wasn't over a half an hour, but on these occasions they didn't have to take a line ashore.

They left Shafer Well the next morning about 6.30, and arrived at Moab about 7.30 that night. They didn't stop for lunch as they had lunch on the barge. (R. 3380.)

On the trip up from No. 1 Well to Moab they were held up 4 or 5 times in the forenoon, but he doesn't believe they ran a line to shore. He believes that the average time they were held up in the forenoon was from twenty minutes to a half an hour. He would say thirty minutes was the maximum, and five minutes the minimum. (R. 3381.)

He believes No. 1 Well is about 20 or 25 miles below Moab. He believes it was shortly after one o'clock the first time they had to take a line out and that they had gone upstream about 10 miles. (R. 3382.)

He believes that when he said 16 miles below Moab, that that was his best judgment and was an approximation, and that it was just getting dark when they arrived at Moab. This trip was made about the 19th of December [1926]. (R. 3383–3384.)

H. T. YOKEY

For Complainant

(Record, vol. 18, pp. 3394–3449; Record, vol. 31, pp. 5482–5485)

Lives at Elgin (near Greenriver) Utah, having lived there since 1903. (R. 3394.) He is retired. Elgin has about half a dozen houses.

Built and operated so many boats has forgotton how many. (R. 3394.)

Was on Green River in a rowboat in fall of 1903 on a hunting trip, went down as far as the cataracts. (R. 3394.)

Rowed and towed back upstream; towed over the riffles. Makes these hunting trips every two or three years. (R. 3395–3396.) Boat was 15 ft. long; 3½ ft. beam; draft 6 or 7 in. (R. 3395.)

Was chief engineer of the boat called *City of Moab*. Started down in July on first trip, went to confluence of Green and Colorado, and up the Colorado to the Slide. Had a flood stage going down, and could not make it; turned around and started back to Greenriver. Within ten miles of Greenriver, abandoned the boat. Trip took about ten days. Hit sand bars a few times, only had one hub on the propeller on one side and one blade on the stern; it was time to quit. (R. 3396–3397.)

Boat remodeled after being tied up three or four months and renamed *Cliff Dweller*. (R. 3398.) Made a trip in July. (R. 3399–3400.) Went down to Valentin's Bottom about a hundred miles. Coming back the boat was a little long coming over the

riffles and the wheel would lift out of the water; necessary for one man to get off and take a line ashore, so that boat would stay in the water. At Fort Bottom had to pull off sand bar with capstan. Got on at noon and did not get off until evening. (R. 3401.)

Stuck at a place called Hell's Hole on trip down (R. 3402), at about two in the afternoon; in the morning the sand had cut out and the boat floated; this was about 35 or 40 miles below the railroad bridge (at Greenriver) and below the mouth of the San Rafael about 15 miles. Anchor weighing about 150 pounds thrown overboard. (R. 3402.) Carried no freight or passengers, just guests.

At low or medium stage of water no trouble to go through the Slide, but in the high stage a craft can not go through. (R. 3403.)

Stuck on bar at Brigham's Aleck. (R. 3404.)

Going upstream had to stop at Wimmer's Ranch and raise the engines as paddle struck below bottom of the boat. Stopped two days. (R. 3404.)

Cliff Dweller only made one trip, made a couple of little side trips and was sold and moved to Salt Lake. (R. 3405.)

Compt. Exh. 473 is Log of *Cliff Dweller*, which was copied into record. (R. 3409.)

(Complainant's Exhibit 473, as offered in evidence is as follows:)

The cruise of the *Cliff Dweller*—Log of the good ship *Cliff Dweller*: C. W. Anderson, Master; H. T. Yokey, Chief Engineer.

Under Heaven in the year Anno Domini MCMVI, on the sixth day of the month of August thereof, there sailed from the port of Green River in the State of Utah, U. S. A., the good ship *Cliff Dweller*, manned in the following manner: C. W. Anderson, Master and Pilot; Alex Wahlstrom, Head Fireman and Stoker Crew; Bill Newby, Chief Officer of the Deck; Frank Anderson, Crew; Isidor Wise, Pantryman and Chef. The destination was the junction of the Green and the Grand Rivers, and following is given the true log of the cruise from day to day:

1906 August 6 (Monday): Left Green River at 9 A. M. Nooned at Wimmer's. Tied up night at Hell's Hole.

August 7 (Tuesday): Tied up night above old Fort Bottom.

August 8 (Wednesday): Tied up night above Brigham's Aleck.

August 9 (Thursday): Arrived Valentine's 11 A. M. Twenty miles from Junction. Visited Cliff Dwellings, Cave of Winds, etc.

August 10 (Friday): Left Valentine's on return at 9 A. M. Tied up night 5 miles below Bow Knot.

August 11 (Saturday): Tied up night at Three Canyons.

August 12 (Sunday): Arrived Riverside 9 A. M. Tied up.

August 13 (Monday): Raising engines and overhauling boat.

August 14 (Tuesday): Working on boat. Oppenheimer boat arrived from Green River, busted herself

and tied up. (She stripped a cast-iron steel (?) pinion.)

August 15 (Wednesday): Started for G. R. with Oppenheimer, Durant, and Wimmer. Tied up night at Little Bottom.

August 16 (Thursday): Took on Henry Halverson and arrived at Greenriver 3 P. M. (R. 3409–3410.)

Built the *Black Eagle* and made a trip down the river in latter part of summer to Valentines Bottom; water tube got full of mud, and boat blowed up. (R. 3411–3412.) It was 40 ft. long; 6 ft. beam, 7 or 8 in. draft; tunnel construction.

Built another launch and went down and brought the boiler and engine of the *Black Eagle* back to Greenriver. (R. 3412–3413.)

Remembers the boat *Wilmont* belonging to Wolverton was sunk right below his house. (R. 3413.)

Launch built to get the engine off the *Black Eagle* sold to Fletcher and Butler and they took it down by way of Hanksville to North Wash, and lost it at Hite. (R. 3413–3414.) Tied it at Tickaboo Rapids because they could not make the rapids. It was 28 ft. long, 5 ft. beam, 8 in. draft, 10 H. P. (R. 3413–3414.)

Built a barge to move supplies for Mr. Richardson of the Government Survey party. Loaded with about one thousand pounds of supplies and took down to Halvorsens Ranch and loaded with supplies that had been hauled from Greenriver. (R. 3416.)

Took it downstream lashed to a 6 H. P. launch. Barge was sold for $5.00 and believes it is down there

on a sandbar. (R. 3417.) The barge was 8 x 32. (R. 3415.)

There were two launches; does not know what became of the Anderson launch, but believes his is at the bottom of the river. Does not know of any power boats on the river now. (R. 3418.)

Cross-examination (R. Vol. 18, pp. 3419–3444):

A boat of a draft of 18 inches would have to have two feet or more of water to run; where the river splits up into two or more channels, real low water you would not find it. (R. 3422.) If it was all in one channel you would get that much water. (R. 3424.)

Three years ago, only occasion when there was not a channel in the Green river that would take a boat having a draft of one foot of water. (R. 3425–3426.)

Between junction of Green and Colorado and mouth of San Rafael there are places where river spreads out, the water was as shallow as at places between Greenriver and mouth of San Rafael. (R. 3426–3427.)

If had not been traveling back and forth when Reclamation barge was taken down, probably would have been stuck good and tight. (R. 3427.) Difficulty usually in finding the deeper channel, sometimes pretty hard to find. Always reaches destination.

He has neither seen nor carried large loads of freight up and down that river. No incentive to haul any great traffic down there, except for Reclama-

tion Service, which was biggest tonnage he ever took down. (R. 3427–3428.)

Where most of current is, if you keep running across and agitating the sand, traveling the same route the next two or three days, when river rises, a channel would be enlarged, and current would be in one channel instead of spreading out in two or three. (R. 3429–3430.) Thirty miles below the Greenriver railroad bridge the trips would have no effect, because that is gravel. (R. 3430.) From there on down is sand, and frequent trips would cause it to cut channel as river is falling and benefit it.

Would only accept a contract to deliver freight and merchandise between the mouth of the San Rafael and the mouth of the Green before the middle of July; would want to go down and open up a channel; would not take a contract later than July; where boats had not run during the year, river spreads out, cuts three or four channels. No channels to be found unless you get on the river when river is dropping, medium stage. (R. 3433–3439.)

Some places could go down with channel being cut, some places could not. (R. 3440–3442.)

If compensation was enough he would tackle getting a thousand pounds of supplies down the river if boat had not been down this year, and would get there in course of time. Next trip would not be any cheaper. (R. 3443–3444.)

Redirect examination (R. Vol. 18, pp. 3444–3446):

River cuts more when it is falling. (R. 3444.)

River rising effect is different; crossing bars in different places, bars on inside of bends, could not tell exactly where bars would be; when river falls, cuts out and spreads out and deposits may be half a mile farther down. That is the time to be running boats to make a channel. (R. 3444-3445.)

Plenty of water on the outside of a bend. (R. 3445.) Crossing from one bend to the other you get the trouble locating the channel. (R. 3445.)

Recross-examination (R. Vol. 18, pp. 3447-3448):

In 1903 4 5 went down the river deer hunting; it was in October. Trips made in a rowboat. Easier to find a channel coming upstream; going down have a current three miles faster. (R. 3447-3448.) These trips made in rowboat not a power boat.

It is a good deal easier to find a channel coming upstream than going down; going down you have a current three miles faster; to get steerage way coming back up you run slightly faster than the water, to keep ahead of it and get steerage way; you have plenty time to pick out your course and find the channel. Coming down, you would have trouble, because you come on to it too suddenly. (R. 3447-3448.)

Further examination (R., Vol. 18, p. 3448):

On the barge that he built to take supplies on the Government expedition he loaded ten tons, and went to the junction of the Green and Colorado Rivers and cached the stuff there. (R. 3448.)

Recross-examination (R., Vol. 18, pp. 3448–3449):

He has a cruiser made of fourteen-gauge iron and wire, that is 22 feet long, with a 5-foot beam.

That boat has not yet been launched, but he intends to launch it on the Green River, some of these days. (R. 3449.)

This boat has an 18-inch propeller and a skag below of 10 inches, that draws too much water and he has figured on installing a stern wheel.

If Mr. Hoover and Mr. McDonald don't stop him, he expects to go down to the junction and up to Moab. (R. 3448–3449.)

Recalled in Rebuttal (R., Vol. 31, pp. 5482–5485):

The Government supplies he hauled was done before Mr. Wimmer got on the job. He never took a pound of freight from Wimmer's Ranch, it was all taken from Greenriver, and consisted of a thousand pounds. Mr. Richardson wanted ten tons of supplies taken down. The balance, whatever it was, he took down from Halverson's Ranch, before Mr. Wimmer got on the job. The survey of the proposed dam was completed before that time, and this had to do entirely with the survey party and not with the drilling party. (R. 5483–5485.)

JOHN BERNARD REESIDE, JR.

For Complainant.

(Record, vol. 21, pp. 3920–3935; Record, vol. 22, pp. 3937–3949)

He resides at Hyattsville, Maryland; is by profession a geologist in the employ of the United

States Geological Survey, and his official position is a specialist in stratigraphy and stratigraphic palaeontology.

He has been on the Colorado River from Moab down to its junction with the Green, and has been along the banks of most of the part above Moab as far as Glenwood Springs, with the exception of that portion near the Colorado state line that is known as the Uncompahgre Plateau.

The trip from Moab down to the Green River by boat was made August 4th to 10th, 1926, with Mr. C. E. Turpin. (R. 3921.) The trip started August 4th, 1926, in a sixteen-foot boat made, he thinks, by the Evinrude people and propelled by an Evinrude outboard motor. He understood that Mr. Turpin purchased the boat from the Evinrude people and had it shipped to Moab. Mr. Turpin operated the boat and he, Reeside, was lookout and observer.

The purpose of the trip was to make a reconnaissance of the geology along the river banks, the nature of the country, whether it would be feasible to take parties down to work out from the river, and and other facts that could be obtained that would be useful for the study of general geological work and for the use of the parties.

There were at that time two parties working on the river; one north and the other south of the Colorado River, and it was expected that they would both work the river and have a map of the banks of the river. These parties were primarily engaged in

mapping areal geology or structural features of the country, showing its possibilities for oil and gas productions.

He used his notes as a guide and notes that on August 4th they travelled thirty-four and one-half miles by river to about Mile 30.5. His notes do not indicate time he landed at Moab, but from his recollection, judged it to be about 10.30 A. M. (R. 3922–3923.) Mile 30.5 is taken from the old Green River map, which begins at the mouth of the river as zero.

On the trip the boat was grounded in a number of places, the exact locality of which he is not able to say. He was lookout and had to get out and wade around to find where the best possibility of going ahead was and would drag the boat in that direction alone, if possible, until the water got knee-deep, which was deep enough to float the boat. Mr. Turpin would be sitting in the boat ready to start the motor the minute it would be free to go ahead.

They had one particularly bad time at a place a few miles above Kane Creek, where the outside curve of the river, which ordinarily would be deep, was taken and there was not enough water to float the boat. He got out, waded around fifty or sixty yards on each side of the boat, perhaps farther, without finding deep enough water. Mr. Turpin had to get out finally and, with one pulling and the other pushing and lifting as much as possible, edged the boat down and dragged it one hundred yards or more before reaching deep enough water to float it.

There were no other groundings that caused as much trouble as that one. The boat struck bottom many times, and he had to get out to find deeper water, and would drag the boat in the direction where there seemed to be water sufficient to float it.

On the 5th [August] they made the junction of the river without any stops and turned up the Green. They made a number of groundings on that day before they reached the mouth of the Green, but he is unable to tell the precise locations. There were a number of places where he had to get out and wade, trying to find deep water for the boat. Trouble was had at the mouth of Salt Wash at Mile 3.5, where there is a rocky rapid due to material brought down Salt Wash in flood stages, and it was necessary to drag the boat by there. (R. 3924–3926.)

They turned up the Green River about three miles and were fighting shallows all the time, it requiring three hours to make the trip; there didn't seem to be any place where they could run fifty yards straight ahead, and they finally decided that there was no use trying to get the boat any farther up, so turned and came back the same day and went back up the Colorado as far as the slide, where they camped for the night.

Had difficulty upstream with sand bars; stopped all day at The Slide on the 6th of August, and through a section up the side of the canyon wall, and again tried to get out on the first bench. They were unsuccessful, as it was utterly impossible to get out

there. On the second day they started up, and it took them half an hour to get the boat past the rocky places at the mouth of Salt Wash. They finally had to virtually drag the boat 100 or 125 yards, the man behind pushing and the man in front pulling, and getting it along the best they could. (R. 3926–3927.)

He made an examination of the "Slide" but it would be very difficult to determine its age in years because in human years changes are not rapid. A geologist would call it a recent slide, but that might mean 100 years, 500 or even 1,000 years. Many of the rock faces appeared fresh and unweathered. The weathering is not rapid in that place. (R. 3927.)

The "The Slide" is a large mass of loose rock, in great pieces four or five feet in diameter, and on down to much finer material, and which has fallen so near the upper part of the right bank of the river. It has constricted the river width to about 120 feet there, and the water goes like a mill race through that little area, but that great mass of loose rock goes out into the bed of the river and restricts the normal width. (R. 3927–3928). From memory he would say the slide was 250 feet wide. It is composed entirely of loose rock which now rests on what probably was the river bottom. It sticks out just like a boom into the river. It is difficult to climb over. There is no method known to geologists whereby the age of the slide could be determined and if there is no one who saw the river before the slide was there and afterward, there is no way of telling its age in

years but geologists think it is very recent. If there were trees growing on it you might get an idea of its minimum age. There were box elder trees six or eight inches in diameter right close to it but none that were actually growing on the slide.

In going up the stream they camped right at the edge of the slide; they had no tent and just slept on the sand. The next day [August 7th] they went from the slide up to Mile 22, grounding a few times; he does not remember the specific places, but he has a record that it required nine hours' time, the distance being twenty miles. (R. 3928-3929.)

The work which he was doing did not require that he stop to get out of the boat except to keep the boat going, because the tops of the rocks in all that part of the valley are low and rise so gently upstream that you see them for miles, and nothing is covered. His work up and down the river did not engage his attention as much as it interfered with the operation of the boat; he could look around and see that the strata were the same for long distances back and ahead. Mr. Turpin attended to the engine and watched the river quite closely, as did he, too, looking from the river to the walls and back again.

The next day, August 8th, they went from Mile 22 to Mile 38, a distance of twelve miles. They got a late start, because of making a collection of fossils at Mile 22. (R. 3930.) They knew they were at those particular miles because they had a map of the Grand River, and the topography of the bank and side can-

yons was sufficient to tell the location on the river; he does not think there was any time when he could not tell within one hundred yards where they were on the river.

On that day [August 8th] they had a lot of trouble just below the Kane Creek Well, where they spent some time trying to find a way to get the boat upstream, and, as he recalls, waded very nearly the width of the river trying to see a place where the boat could be got over easily; finally decided that it would be simpler to get out and haul it, so the two of them hauled the boat somewhere near one hundred yards before getting into water up around their knees. (R. 3931.)

The map which he had showed only the sand islands, there being some in that stretch, but they had changed their positions since the map was made. The map also showed the banks up to a fixed height, the contour of the banks, the mouths and names of side canyons. He identifies pages 17, 18, and 19 of Exhibit 10 as the maps which he used on that occasion. (R. 3931-3932.)

The next day [August 9th] they spent a good deal of time collecting fossils near Kane Creek Dome and made only eleven miles, although he does not recall any great trouble.

August 10th they went the balance of the way up to Moab and had a great deal of trouble, striking shallow water repeatedly, but were able to push off.

Their worst experience was just below the dock at Moab, because during the time they had been down the river a flood had come down Court House Wash and carried a great mass of mud, rock, cottonwood logs, and other débris into the river. They had come down on the right side of the river just outside the curve and going back attempted to follow that, but soon found they could not go ahead because of the mass of débris that had come in from Court House Wash. At that point he waded practically the width of the river trying to find a place to get through, and finally decided they had better go back and try to come up the river back where they found enough water near the bank to finally get up. It took at least half an hour to get free and get past the obstruction.

Upon returning to Moab the boat was put up at the dock, where they had permission to keep it. The engine was taken off and locked up. (R. 3933-3934.)

He was on the Green River with the A. W. Trimble party in 1922, traveled by boat from Green River City, Wyoming, to Greenriver City, Utah.

He has also seen the Green River from the banks for a distance of about forty-five miles upstream from Greenrivet [Utah], by pack train. The trail leads right along the edge of the water most of the way. He has also seen the Green River from Greenriver, Utah, to the mouth of the San Rafael.

He left Green River, Wyoming, July 13, 1922. Mr. Elwyn Blake, of Monticello, Utah, was the head

boatman and was the same witness that testified at Denver. (R. 3937–3938.) Bert Loper had charge of one of the boats, Blake the second, and Leigh Lint was the third boatman. (R. 3939.)

It is admitted by counsel that his testimony would be substantially the same as has been previously testified to by Messrs. Loper, Lint, and Blake. He made a trip north from Greenriver, Utah, by pack train, July 9 to 12, 1925.

They had a guide and a saddle horse apiece, and a pack horse to carry beds and supplies. The purpose of the trip was to see the rocks along the river at more leisure than he had had opportunity to do when he went through with the Trimble party. He was interested in getting more detail of the succession of rock layers; to determine what rock formations there were between Greenriver and the McPherson ranch, which happened to lie just above one of the pronounced changes in topography. This ranch is just above what are known as the Rome Cliffs. The ultimate object of the examination bore chiefly on the thickness of the rocks above the south face of the Book Cliffs, where there were coal beds. There were parties mapping the coal beds. (R. 3939–3940.)

It was his place to know the thickness of the rocks above the coal beds; to determine how far back one would have to go to reach the line beyond which the depth to those coal beds would make them inconsiderable as a commercial fact. (R. 3941.)

The Trimble party dealt only with topography, the relief and fall of the river, and such engineering de-

tails as that; also, possible dam sites. At that time his function was to make such examination as he could in passing of the rocks at the possible dam sites; to form some idea of their structure and their ability to hold water and to serve as an anchorage for dams, etc. They had no interest in coal or in oil. (R. 3941.)

Going down the Grand (Colorado) River he was working in connection with parties going north and south, mapping oil and gas possibilities; but there is no area of that kind south of the Book Cliffs, except some impure coal, which is not considered of any value; much lower rising than the Book Cliffs, where the coal is commercial.

He did not make an examination of any particular dam sites north of Greenriver, Utah, because at the time the data was gathered, the hydrographic engineers with the party had not settled on just what sites they would consider, and the most that he could do was to get such information in passing as he could, of anything that was considered a possibility. (R. 3942.)

He didn't make any trip down the Green River, below Greenriver, Utah, on the river itself, but he has been along parts of the banks, as far as the mouth of the San Rafael by wagon and by horses. The road from Greenriver, Utah, to the mouth of the San Rafael is only a road by courtesy, as it is just a trail or a wagon track. (R. 3943.) You can get over it by wagon. It is almost impossible by auto-

mobile; because a team can lift a wagon over where you would have to jack a car. There is another road which lies back from the river, which is somewhat sandy, but which is traversed by automobiles. That is the road which was used by various people in going back to Elaterite Basin. The road that he went over in a wagon was a shorter road and kept to the river. (R. 3943–3944.) He has been to Elaterite Basin twice, but this trip was made from August 16 to August 20, 1925. He saw no boats either above or below Greenriver, Utah. He has been on the San Juan [River] below Bluff, in 1928 and 1929.

He accompanied Mr. Baker in making studies of the stratigraphy, for use in connection with his studies of the oil and gas possibilities of the river region, south of the San Juan River, in Utah. (R. 3944–3945.) He means by that Mr. Baker had a party mapping early rock formations south of the San Juan River and determining the units into which the rock should be divided—what units of the rock should be mapped, etc., and it was part of my duty to work with him in making those divisions, and in studying what the equivalents of those divisions would be in adjacent regions and their thicknesses, and what fossils they may have contained, for helping in comparing the rocks of that region with the rocks of adjacent regions—such details as that. This was west of the 110th Meridian. It is the land that lies off the Navajo Reservation, in Utah, for this specific study; but in our studies of the stratigraphy we took in a much larger area. (R. 3945.)

He touched the San Juan River himself in the canyon above Mexican Hat, where the road follows the river for some miles, right at the water's edge. He saw it at Mexican Hat, and for several miles above, saw it again at the mouth of Johns Canyon. He was on both sides of the river, and saw it again at the mouth of Copper Canyon, and at the mouth of Trachyte Creek. He was only on both sides of the San Juan River at Mexican Hat, and during the time he was on the San Juan River he didn't see any boats. He recalls seeing no other people in the canyon, other than those of his party. He has done a good deal of work on the upper reaches of the San Juan River around Fruitland, and he didn't see any boats on the river up there. He was in that part of the San Juan from June to September, inclusive, of 1915 and 1916, June to August of 1917, in June and July of 1920, and the same months in 1921. He has been back for short periods nearly every summer since then, has been back in the region for one, two, or three weeks several times.

Cross-examination (R., Vol. 22, pp. 3947-3949):

He saw no boats on the San Juan River at Fruitland. When he was on the Colorado River, between Moab and the mouth of the Green, he spoke of grounding a number of times, between Moab and a point thirty and one-half miles up from the mouth of the Green River, and he also spoke of some special difficulty he had in the vicinity of the Kane Creek

Well, on the trip back upstream. This was below the Kane Creek Well. (R. 3947.)

He doesn't recall testifying that he had some special difficulty about ten miles from Moab, on the upstream trip, but the special difficulty that stands out in his recollection was just below the dock at Moab; "that particular thing stands out as the greatest difficulty." R. 3947-3948.

He encountered about the equal in obstacles to navigation on the upper half of the river, between Moab and the mouth of the Green, as he did on the lower half of the river; there was just as much trouble below as there was above—in the matters of grounding and being able to get off with a lesser degree of difficulty. From the standpoint of running aground and being able to get off with a lesser amount of difficulty than the special places which he mentioned before the lower half was equal to the upper half. So that from your observation of the river he would say that the difficulties of navigation were about the same in all parts. (R. 3948-3949.)

RAY BONNER WORTHY

For Complainant

(Record, Vol. 22, pp. 3949-3957)

He is of Saltville, Virginia; an engineer by profession, and at the present time is operating a rock quarry for the Mathison Alkali Works. (R. 3949.)

He was formerly in the Government Service for three years at Yuma, in the capacity from chainman up to instrument man. Then he went as instrument

man and chief of the party on the Colorado River Basin Service, also being at points on the Green River. He was first on the river from Greenriver, Utah, down to its junction with the Colorado River in the summer of 1914; the trip commenced the 10th of July, and finished the last part of August, he believes. The object of the party was to survey reservoir and possibly dam sites, situated at the junction of the Green and Grand Rivers. (R. 3950.)

From Greenriver, Utah, down to the junction, a topographical map, on a 1,000-foot scale, and 25-foot contours, within about 200 feet of relief was made. On the upper end of the survey the contours were made at the water surface, and the proposed dam site 225 feet above.

Mr. Sawyer was in charge of the survey, and Mr. Richardson in charge of the work. Besides them there were seven or eight other men. His particular work was instrument man operating a plane table. (R. 3950–3951.) [The boats used were the same as have been described by Mr. Sawyer and Mr. Richardson.] He, Worthy, did not work on the drilling outfit [at the junction of the rivers]. (R. 3951–3952.)

He made observations in connection with condition of sand bars in the river. Whenever they ran up on one of them with their boats, they noticed them to their sorrow. (R. 3952.) He could not help noticing those sand bars that formed; sometimes there would be two or three channels going through a sand bar, and their problem at that time would be to

pick the proper channel. (R. 3954.) During the trip the water was in a receding stage, and although they were moving rather fast down stream the recession of the water must have had an effect on the river and the sand bars. (R. 3954.)

Below the mouth of the San Rafael, it was necessary to cross the river back and forth, because it was confined to the canyon walls and the survey was also confined almost entirely to the canyon.

He traveled downstream in a rowboat, the motor boat being used for pushing the scow, and he did not see any other boats on the river, except the ones that were used by his party. On the way down he saw one man on horseback, about fifteen miles below the San Rafael. The horseman was going down and the party was coming back and were met by the *Marguerite* with some mail. He saw no settlers. (R. 3955.)

Compl. Exh. No. 479 he identifies as a picture of the *Betsy Ann*, stuck on a sand bar, and he thinks he is one of the persons depicted in the photograph. (R. 3955–3956.)

Cross-examination (R. Vol. 22, pp. 3956–3957):

While surveying down the river he would travel near the shore line and work from side to side, making a set-up wherever they were available and in a desirable location. Frequently he landed during the day and would naturally cross back and forth. (R. 3956.)

The SPECIAL MASTER: Let it appear in the record that the witness thinks but is not positive that the picture is on the return trip.—Compl. Exhibit 479. (R. 3957.)

WALTER EVERETT MENDENHALL

For Complainant

(Record Vol. 19, pp. 3452-3529)

Resides in San Juan mining region, Lake City, Colorado: 70 years of age.

Most of his life has been spent in the neighborhood of the San Juan and Colorado Rivers. (R. 3452.)

A rapid is rough water, more or less dangerous, filled with large rocks; riffle is a milder type, water running rapidly, with some riffling over gravel beds, often shallow, seldom very deep. Rapids carry higher velocity and greater fall. (R. 3452–3453.)

In 1893 went from Lake City, Colorado, by team and wagon to Bluff on a prospecting trip. Started latter part of June. Hauled some lumber from Bluff to mouth of Comb Wash and built a boat; it was 15 ft. long, 3½ ft. wide; draft, 8 inches; loaded it with picks, shovels, supplies, and camp equipment and went downstream eight or ten miles. Trip made latter part of July. Does not remember the depth of water but recalls the Indians forded a good deal on horseback. (R. 3453, 3455.)

Had a raft he had built, 8 by 10 feet, with the boat and it ran on a submerged rock and they had to tear it up to get it out; caught the pieces of lumber below as they came down. Did not rebuild the raft

(R. 3455–3456.) River swift all through the canyons, with riffles and rapids. (R. 3457–3458.)

Built a water elevator or Chinese pump 8 or 10 miles below Comb Wash, and that night a flood came down Comb Wash and took it away. (R. 3458.)

About twelve or fifteen prospectors there then. (R. 3459.)

All traveling while prospecting was done overland and they remained in that country nearly a year. (R. 3460–3461).

Established the Mendenhall trail by means of pack animals. (R. 3462–3463.)

First went to Nokai in September, 1894. Made a boat at Bluff; just a straight scow. Took it down to his camp five or six miles below the mouth of Gypsum Creek; fairly good stage for low-water season; went through all right, but had to line down a number of places. Walked back to the camp, and five of them started down the river with four boats they had built. (R. 3465–3466.) Usual length of boats 15 ft. long, 3½ ft. wide. (R. 3463–3464.) Had a heavy outfit and it was hard at first to get through the canyon because of rapids and very swift water. (R. 3468.)

At Clay Hill Valley, river gets out of canyon and goes into a wide channel, and had a little trouble with sand. Sometimes bothered in getting a place to land. (R. 3468.) Eventually went to the mouth of the San Juan River. (R. 3469.)

Piute Farms are half a mile from San Juan River in a little valley that runs down Nuggett Creek.

Space not larger than the Salt Lake Postoffice Bldg. (R. 3471.)

At Nuggett Creek, San Juan has a wide channel, spreads out, has a great quantity of sand throughout the channel and this extends through to below Nokai Canyon. Got boats through this stretch fairly well. (R. 3471–3472.)

Encountered rapids at mouth of Copper and Nokai Canyons. (R. 3473.) Two rapids at mouth of Piute Canyon and a mass of material brought down by Piute Creek. (R. 3472–3473.)

Eight or ten miles below Piute Creek there is a long rapid with a heavy fall, possibly about eight or ten miles from the mouth of the San Juan. Pulled boats across sand bar at mouth of river and found a little difficulty in finding any channel for the big boat. Became pretty expert handling oars around sand bars when they got through. (R. 3474.)

They went up to Hole-in-the-Rock Crossing on Colorado River by rowing, towing, and lining the boats most convenient way they could. (R. 3474–3475.)

Pack train which had come overland was swum across the river; he crossed in the boat. Party met at Hermit Lake. (R. 3475–3476.) Supplies obtained from Loa were hauled to California bar, he returning to California bar on horseback. (R. 3477–3478.)

Remained at California bar until March or April, 1895. Probably fifteen or twenty men there besides his own party. (R. 3479–3480.) Mr. Chaffin brought supplies in overland.

Three of them took three boats and went down the Colorado on a prospecting trip to below Lees Ferry: Saw no other prospectors between Hall's Crossing to Lees Ferry. Walked from California bar to Hite, some 35 or 40 miles, for his mail. (R. 3482.)

Trip to Lees Ferry interesting trip, contending against river, elements, winds; some not large rapids; good deal of swift water. Left Colorado River at mouth of Soap Creek Rapids and went on foot to Flagstaff. (R. 3483.)

Spent from September, 1894, to 1st of April, 1895, on this trip from point on San Juan River to where he left the Colorado River. (R. 3483–3484.) Was prospecting. Was on San Juan next in 1928.

Believes he lost a big boat on the Colorado River in the spring of 1895. (R. 3485.) Just below the mouth of the San Juan; wind was blowing upstream so hard, such high and choppy waves they could not get along. Boats were tied up, but big boat became loose and was gone. (R. 3487.)

Their supplies and equipment were in the big boat; three miles below they found the boat stranded on a submerged sand bar. The boat had gone through the rapid alone, but rapid was not so bad after wind had gone down; this rapid is the roughest water between the mouth of the San Juan and Lees Ferry. (R. 3488–3490.)

Portaged in going into Aztec Rapid, lined the boats partially light.

Made a trip on the Colorado River in 1907 from Grand Junction to the head of Westwater Canyon, in August or September. (R. 3490.)

Worked some placer ground in Richardson Valley about 20 miles from the Cisco pumping plant, and in the spring of 1908 started down the river in a skiff. (R. 3491.) Also had an old scow. Went through the rough water to Moab, on down to Cataract Canyon. (R. 3492-3493.)

Rough water above Moab is in Richardson valley at the mouth of the various washes; rapid at the mouth of Castle Creek and below Castle Creek at Salt Wash. (R. 3492-3493.)

Did not meet any other boats traveling up or downstream.

Saw one boat that cattlemen were using in Jackson Basin, neighborhood of Island Mesa. (R. 3493-3494.)

Went to the 11th rapid in the Cataracts and left boats there. Found an inscription "F. W. Wright passed here in 1876. Lost one boat in this rapid." (R. 3494-3495.) Did not go clear through Cataract Canyon on this trip. Took boat and went upstream to Moab, went up any way they could. Easier to tow than to row. Did some poling. (R. 3496.)

Made a trip overland in 1916 from Moab to Greenriver, down to Hanksville and down North Wash to the Colorado River at about Hite. Did not go down the Green River on account of ice. Built a boat and went down to the Narrows above the mouth of the

San Juan; was stopped by an ice gorge and could not get through and went overland to the San Juan River. He could not get to the territory he wanted to, and returned to his camp on the Narrows. (R. 3496–3498.)

Worked the boat back up through the rough and swift water to Hanson Creek. Sometimes made five miles a day rowing and towing. Loaded their stuff on the mules and took the trail on the west side of Colorado and went back out. (R. 3498.) Went back overland to Greenriver. (R. 3499.)

About the middle of February he built a boat at Greenriver, in 1919, and started down the Green River following the ice. Ice went out altogether below the mouth of the San Rafael, and they went onto the junction. (R. 3500–3501.) Went up the Colorado to Moab. Usual kind of a trip rowing and towing. (R. 3502–3504.)

Made a trip overland in a small truck from Moab to Bluff, then to Mexican Hat, in the late winter and spring of 1928; hired an Indian to haul them to the San Juan River just below the mouth of Nugget Creek. (R. 3504–3505.) Built a heavy canvas-bottom scow-shaped boat, 14½ feet long, with draft of not over three inches when they were in it. Went down to mouth of Piute Creek and found that the rapids found there previously at the mouth of Copper and Nokai Canyons had disappeared and were entirely covered with sand. (R. 3505.) Found swift water that was three or four or five feet deep.

(R. 3506.) Found the river at Nugget Creek had more sand and there were no gravel bars. Went down the San Juan about 30 miles and left the boat, going back on foot to their camp. (R. 3507.)

Noted the sand wave condition which was a significant feature of the stream, during his stay there in 1893–1894. Seen similar waves on the Colorado below the mouth of the San Juan. (R. 3508.) Occur generally when floods come down either in summer or spring.

The sand storms on the San Juan in the Bluff and Mexican Hat vicinity are a little more dense than on the Colorado, because the winds blow over a wider expanse of sandy desert, sand and silt desert. But in either case they will start to blow in the morning, as a rule, sometimes the winds will last for two or three days, but generally not so severe as if they only last a day. They will start about eight or nine o'clock in the morning, and by the neighborhood of eleven o'clock, the sun will become completely obscured, see no sign of it, although there are no clouds in the sky.

That continues until possibly four o'clock in the afternoon, and you will notice in the west a lightening of the air, and soon after that comes up the air begins to clear, and by dark it is perfectly clear again, the wind has subsided. They are more common in the spring than any other time, although he has seen them in the latter part of the summer or early fall. (R. 3510.)

Further Examination (R. Vol. 19, pp. 3511-3513):

The sand waves are quite different from waves in a rapid; sand waves are regular. They are not as high. The waves in the bad rapids vary very much; some of them rise up to heights of probably ten or twelve feet. An ordinary rapid, they are about similar in size. By the sand waves being more regular he means they just run in succession of waves, right on down the main current of the stream until they get to the lower end from where they start; they are just like a succession of waves in a considerable body of water that the wind is blowing, run regular until they start to break. They generally start to break about the center, because that is where the waves get the highest. These sand waves are in the main current of the river; that is where the principal waves form; wherever there is considerable current these sand waves will develop. They are in where the quiet water would be. The sand waves form on the riffles or rapids.

So that in the portion of the year when these sand waves do not occur the water at that spot would be more or less comparatively quiet. He has navigated the river through these sand waves; would generally work to get along the outside edge of the waves, where the water would be some shallower, but there is not that action to bother with the rising and falling of the waves.

"Q. Some witnesses have testified that they went down the river with the sand waves, broadside to the waves. Did you do that?

"A. Not if I could help it; it would be pretty risky.

"Q. You went down head on, did you?

"A. Through any rough water we always backed down.

"Q. Stern on?

"A. *Sternmost.*" (R. 3511-3513.)

Cross-examination (R. vol. 19, pp. 3513-3528):

After he made his trip on the Colorado River in 1919, he was again on the Colorado, in and around Moab, from 1922 to 1924, he believes. He was working placer ground both above and below Moab. (R. 3513.)

At this time he used boats on the river and went up above the bridge at Moab about three and a half miles, and down the river below the bridge twenty-two or twenty-three miles.

He has never been back on the San Juan River after his last visit in 1928.

When he was working the bars on the San Juan River in 1894, he took out $4,000 or $5,000 worth of gold from time he started 1893 to fall of 1894. (R. 3514.) He would carry gold out overland (R. 3515.)

When he was there on the San Juan river in 1893 and 1894 he saw other men on the river, and other boats on the river besides his own.

The other placer miners got supplies down the river to that country overland, because it was easier.

And when they had to go further on down below that road that they came over they took them overland; no one ever went through the canyon, so far as he knew, except his own outfit. (R. 3515-3516.)

There were other boats on the river besides his, but he doesn't know about any of the other men bringing supplies down the river from Bluff. His party was lower in the canyon than the other miners, although there were other parties that went down below where he was working. (R. 3516.) Most of them went down overland and down through some of the side canyons. For example, they had one notable trail they called the Honaker trail, about eight or ten miles below their camp; they had a ladder there to get down into the canyon; he has seen it. The ladder was probably twenty or thirty feet long.

In the years of 1893 and 1894 when he was there, there were a good many miners there that were prospecting or working their claims up and down that river. There must have been one hundred or one hundred and fifty in that year, because the discoveries we made in the canyon created quite an excitement. He was the original discoverer. He found the trail by which they could get down in the canyon. Some of the other miners came down the river. Probably some brought the lumber down and built them; not sure of that, though. He saw some come down river in boats; they came down the river and passed our camp to their different places that they were working.

Never saw any men go up the river in boats very far; too hard work; they would rather go out by trail. (R. 3516–3519.)

While he was down there in 1893 and 1894 he believes that Mr. Raplee was working claims there, but he was only acquainted with his [Raplee's] partner, a man by the name of Charles Bullock. He doesn't remember having any personal contact with Mr. Raplee. He doesn't personally know whether they had boats or not. (R. 3519–3520.) He knows that some of the miners working in there didn't have boats. (R. 3520.) Most of them had boats. Got supplies from Bluff, either pack horse or wagon; usually didn't go by wagon, because the road was pretty rough. (R. 3520.)

In September, 1894, when he took the scow down the river from Bluff he only had a few supplies, but he did take some down, and when he started on down the river with the four boats, they were fairly well loaded with their machinery and equipment. He figured all of the material on the larger boat would weigh about a ton, and the small boats had a lesser load.

When he went down the Colorado River in August or September, 1907, there was some rapid water right at Castle Creek, also some between Castle Creek and Moab; but he had no trouble in getting his boat through. (R. 3521–3522.)

From his knowledge of that stretch of the river between Castle Creek and Moab he believes it would be possible to take boats fourteen or fifteen

feet long and three and a half or four feet wide, loaded with supplies, down the river. (R. 3522–3523.)

In his travels over the rivers in the vicinity of the San Juan and the lower Colorado, he has become acquainted with the Navajo race to some extent. (R. 3524.) In regard to the canyons, deep canyons; Indians are very much afraid of the canyons; it is almost impossible to get them to go down with you. In fact, never could get an Indian to go down with us into a canyon. They hear the rocks rolling down there, and they say it is the Great Spirit. That is their idea. By rolling rocks he means the waters, only in high water, the roar of the water isn't much, but there are always rocks crumbling down from the sides of the canyon, and rolling down toward the bottom, and these make a very loud, rumbling sound, many times, if they are large rocks. The Indians seem to attribute that to something else besides rocks rolling. (R. 3524–3525.) He never knew the Indians to eat fish caught from any stream, as there is a legend or superstition that the fish fought the Cliff Dwellers and defeated them repeatedly, and finally drove them into a big bend of the river. The Cliff Dwellers, rather than be captured, jumped into the river, and were turned into what is called the humpbacked fish. For that reason the Indians won't let you get near them with a fish if they can help it. (R. 3525–3526.) He has seen the Indian drawings on the sides of the rocks on the Colorado River. He knows of one on the river itself at Smith Canyon.

These Indian writings and drawings are not as frequent along the Colorado as they are along the San Juan, and he has never seen them in the deep canyons, you find them in the sandstone canyons, which are set back a ways from the river's edge. (R. 3526–3527.)

In all of his experience on the Green, Colorado and San Juan Rivers, he has never lost a boat, except at one time, and this boat was recovered in that case. (R. 3528.)

Redirect examination (R., Vol. 19, pp. 3528–3529):

When he was back in the San Juan country in 1928 he saw two other outfits prospecting in there—one of three men, and one of two. He saw oil men in different places, but these men were prospectors. (R. 3528.)

HOMER J. HITE

For Complainant

(Record Vol. 20, pp. 3560–3605)
(Record Vol. 20, pp. 3648–3649)

Resides at Oklahoma City, Okla.; 63 years old; occupation, traveling salesman for Domuerse Oil Company of Kansas City, Mo. Went to Hite, Utah, in 1888. (R. 3560.)

First went to Greenriver, Utah, or Blake City, as formerly called, from Wichita, Kansas; from there to Hanksville, baggage by wagon and he rode horseback across the desert; distance 60 miles.

Only settlers between those two points, couple of "Swede Boys" on the San Rafael, 20 miles from Greenriver. (R. 3561.)

Hanksville was only settlement of six or eight houses and one so-called store. Went overland from Hanksville, to head of Trachyte Canyon, about 16 miles to Hite, total distance 60 to 65 miles. (R. 3562.) Hite a stockade log cabin and about half dozen men. (R. 3563.) Uncle, Cass Hite, his partner, Joe Burgess, Al Starr, and a boy; engaged in placer mining with father and uncle. (R. 3563.)

Equipment for placer mining hauled from Greenriver to Hite; took six weeks' time. 20 mule team came down Trachyte Canyon, hitched over wagon in order to pull; crossed the creek 144 times in 16 miles. (R. 3564.)

Lumber freighted from Greenriver to Hite; built a barge or big flat boat; loaded would draw five or six inches; 20 ft. long on bottom, 10 ft. beam; equipment loaded on and taken to Tickaboo Bar latter part of April or first of May, 1889. (R. 3565.) Delayed start down waiting for water to rise so would have depth to float boat over the rapids. (R. 3566.)

Went down from Hite to Good Hope and Tickaboo Bars in small flat-bottomed rowboat; found number of rapids; mile and half below Hite first, Trachyte Rapids; around the bend small rapids, dangerous in high water. Tickaboo Rapid No. 1; and around the curve are Rapids No. 2. Considered bad rapids. Swift rapids below the landing at cabin at Tickaboo. Two of that character between Tickaboo and Good Hope. (R. 3566–3567.)

Went upstream from Tickaboo, principally by towing; through most of rapids get out and wade; brace

your feet on slick boulders and pull boat an inch at a time out of the shallow into deeper water at head of the rapid. (R. 3567.)

Post office established at Hite in June or July, 1889; he was postmaster, and mail brought in by saddle and pack horses from Greenriver. He was postmaster until September, 1896; and during that time all mail brought in overland.

Does not believe to exceed 25 people in whole community post office served, including surrounding camps, mountains, cow camps, prospectors, and trappers. (R. 3568.) Territory served, farthest point down river, the mouth of San Juan; cow camps on Elk Mesas about 60 miles; Starr's ranch, 20 miles up in the Henry Mountains; up the river to North Wash; about 50 miles square.

Placer miners and trappers located down near San Juan; come up river by towing boat. (R. 3568–3569.)

Went up river from Hite during first year as far as North Wash. (R. 3569.) Six or eight men placer mining.

Lived on Colorado River from December, 1888, to September, 1896. (R. 3569–3570.)

Only change in character of mining on river was at Good Hope Bar. (R. 3570–3571.)

During the eight years, farthest down river he went was to head of Aztec Rapids; considered the worst rapids between the Cataracts and Lees Ferry. (R. 3571.) Very swift, shallow water, lots of boulders; no definite channel.

Went downstream in 1894 down to Aztec Rapids, Colorado River; between Tickaboo Bar and Aztec Creek, rapids every few miles all away down. Worst ones at mouth of Hanson Creek and the Bullfrog Rapids. (R. 3572.)

Character of river with reference to floods is that in narrow places the river rises 75 or 80 ft. above extreme low level of river. (R. 3572–3573.) At Hite and at Good Hope, highest rise in river was about 21 or 22 ft. while he was there; water so thick with silt and mud could hardly settle it enough to get a drink. (R. 3573.) These floods annual rises from melting of snow; others freshets upstream, cloudbursts, etc. Floods from melting snow usually begin in April and end early in July; during July and August, river very muddy from rains coming down little lateral canyons; sometimes river very low, other times pretty good stage of water; at that time more erratic, more rise and fall than at other times of year. (R. 3573–3574.)

Rising and falling water would destroy a sandbar and build it up another place; never knew exactly where current was going to be. Any little obstruction would cause silt to settle and bar would form. Anything that would take that, it would crumble very fast, and a channel would form in a short time. (R. 3574.)

During September and October water usually low from then until following spring, except for rise caused by rains. (R. 3374.)

During November and December river very low, sometimes nearly covered with ice, except the swift water; January the same; February and March began to warm up, better stage of water.

Placer mining stopped in high water, extreme low water, and cold weather. (R. 3575–3576.)

Never saw a power boat on the river; miners used small flat-bottom boats for prospecting purposes. (R. 3576.)

Saw the boats of Stanton party, the Brown and the Best parties. (R. 3579.)

One man staggered into camp; had lost his outfit traveling up in the rapids; made a raft at mouth of Dark Canyon of railway timbers; at Hite current drifted him to willows and he came up to camp. He was just about dead. (R. 3579.)

Cross examination (R. Vol. 20, pp. 3579–3584):

Beaver and otter principal animals trapped. (R. 3579–3580.) Trappers come up in spring with hides in boats, dry hides and take them overland to Greenriver.

Believes he saw men twice going upstream, using either a blanket or some type of sail. (R. 3580–3581.)

Scow he built of lumber brought in with 20-mule outfit, bottom built of 2-inch lumber; sides part way up of 2-inch, bends or rods are of 2 x 6's; frame and rest of inch lumber 12 inches wide. Heavier timbers used for bottom a part of way up nailed to heavier keels, 2 x 6's. Equipment taken down on scow; five or six men. (R. 3582–3583.)

Redirect examination:

Boat taken down river, never taken back; torn up and used for building sluice boxes and other things.

His trip on Grand (Colorado) River in 1896 between Cisco and Moab (R. 3584) was made latter part of June, reached Moab on July 3rd: water at too low a stage to attempt to boat down, walked down along talus on side.

At Moab he saw ferryboat and one or two rowboats. (R. 3586.)

In 1892 or 1893 he made a trip on the Green River from about a mile above the railroad bridge at Greenriver [Utah] to about the junction of the Green and Colorado Rivers. He could not fix the exact point where the journey terminated, because at that time the only settlement or habitation on the Green River was Wheeler's Ranch, which was about twelve miles below Greenriver by wagon road, and about twenty-five or thirty miles by the river below Greenriver Station, and from there on down there was absolutely nothing or nobody that he knew of between there and North Wash above Hite. This family was going down there to settle on a big flat that was there. (R. 3587.) Had flat-bottomed barge; it was very similar in construction to the one that they took down the river, although not so extensive, and not so well built as the one they took our machinery down the river with. (R. 3587–3588.)

The trip was made in July or August [1892 or 1893]. The boat used drew about four to six inches of water.

He has seen the son and the daughter of the settler, whose name was Valentine, once or twice since. (R. 3588.) The bottom where the settlers stopped is known as "Valentine's Bottom."

From the time the journey commenced two days were required going to Wheeler's Ranch, and the two milch cows that were on the boat were unloaded at Greenriver because the water was too shallow to cross the bar near the railway bridge, and they were driven down to Wheeler's Ranch. At Wheeler's Ranch they were loaded again; just below the ranch the boat got stuck; the cows had to be taken off and were driven up over the canyon wall, around over the mesas about twenty or thirty miles and down to the river.

The progress of the boat was uneventful, except for lodging occasionally on bars, where the water was not deep enough to float the boat. He does not remember exactly how long it took to make the trip, but thinks he was about a week going down. (R. 3589–3590.)

After reaching his destination he climbed out over the canyon walls and went back to Greenriver [Utah] on horseback with the Wheeler boys.

That is the only trip he ever made on the Green River that far down, but has made shorter trips. These shorter trips were made from below the mouth of Price River to twenty-five or thirty miles below Wheeler's Ranch.

On these trips he used a small flat-bottom rowboat, and sand bars were nearly always encountered. He

does not recall seeing any boats on the Green River, except at Wheeler's Ranch, and a couple at Greenriver Station. (R. 3590.)

These boats were just small rowboats, except the ferry at Greenriver, which operated at certain stages of the water. The ferry was operated when the water was deep enough to cross, and not too high to be dangerous. During low water, the river was forded on horseback. (R. 3591.)

Recross-Examination (R., Vol. 20, pp. 3591–3605):

It is about seventy-five miles by way of the river from Cisco to Moab. There is no wagon road down the river, the road extending down only to Richardson, about thirty-five miles below Cisco. (R. 3591.)

He swam across the river to get the boat, about seven miles below Cisco, because that was a real nice stretch of the river and the water was deep. (R. 3592.)

He could not give the number of second-feet [of water] in the stream; the place where he crossed being a narrow, sluggish, deep portion of the river. There was not a ford at that place; it was merely a place about twenty feet wide, used for going back and forth across the river. The deep water was about that wide [20 ft.] and the stream was not broken into channels.

In order to reach the deep water, he had to wade just a few steps on the one side; on the opposite side there was a straight bank which dropped off suddenly. He did not attempt to see how deep the water was, but it was too deep to wade. (R. 3594.)

He wanted to get on to the opposite side of the river because there was a trail there, and it was the only way in which he could get down to Moab. When he swam over to get the boat he did not have in mind getting it to go down the river. (R. 3595.)

He went from Greenriver to Cisco with the idea of getting saddle horses to take down to Richardson [on the Colorado River]. From there, he expected to go to Moab, and was going down the river for the purpose of inspecting specific placer bars, which were located about thirty miles below Cisco and seven miles above where the canyon boxes up below the Richardson post office. (R. 3597.)

He does not recall any boat available except the water-soaked boat which he swam across the river to get; and did not take material with him to build a boat; they would have got a boat to go down in if they could have, but they could not.

He does not know if the place where Valentine and his family stopped, when he took them down the Green River in 1896, is known as Valentine Bottoms. The persons comprising the family were Mr. Valentine, his son, Lee, three daughters and two grandchildren. One of the grandchildren was twelve or fifteen years old, and the other, six or seven years old. The women and children were in rowboats. (R. 3601.)

The large, flat-bottomed boat was used for carrying household goods, equipment, supplies and the cows part of the way. The last time the cows were loaded on the boat, they were taken clear to the point of destination. The distance was hard to approximate. They were camped one night, and reached their destination by early afternoon of the next day. (R. 3602.)

He made arrangements with the Wheeler boys to meet him with horses on his way back. The boats that were taken down the river were kept by Mr. Valentine for his own use. From Valentine Bottoms to Greenriver overland by horseback is about fifty miles. (R. 3603.) Could not have taken the scow back upstream.

The result of his investigation made about the boat there, was he could not get down with the boat. (R. 3603–3604.)

Recalled (R. Vol. 20, pp. 3648–3649):

When he was working in and around Hite, Utah, supplies were brought up and down from Dandy Crossing to Tickaboo and Good Hope, then over a trail above the river; except the heavy, unwieldy stuff. He had as many as twenty pack animals at Hite. (R. 3648.)

The material packed consisted principally of provisions and supplies, and the trips were made principally in the wintertime. (R. 3649.)

Cross-examination (R. Vol. 20, pp. 3649):

His recollection of the freight that went by boat and the freight that was packed between camps is the same as it was as stated in his previous examination. (R. 3649.)

JOHN P. HITE

For Complainant

(Record vol. 20, pp. 3605-3649)

Resides at Oklahoma City, Okla., 73 years of age; lived in Territory of Utah. (R. 3605.)

Came to Utah from St. Louis to Greenriver, and overland to Hite, Utah, in 1888. Trip the same as Homer J. Hite. (R. 3606.) Is a brother of Cass Hite. (R. 3606.)

Remained at Hite from 1888 until 1925, and was postmaster, succeeding his nephew, until the office was abandoned July 1, 1914. (R. 3607.)

Has boated from the mouth of the Dirty Devil down to Lees Ferry, making one round trip, and two trips down.

First trip with Mr. Stanton in 1899 to Lees Ferry, starting back New Year's Day, 1900. Three boats used. Brought back a gasoline launch for Mr. Stanton from Lees Ferry. (R. 3608.)

Commencing at Hite, Trachyte Rapids (in Colorado River) considered one of the worst on the river. Next rapid Big Rock, and then Tickaboo rapids

No. 1 and No. 2. Rapids at Smith's Fork very shallow. Got out and dragged the boats. Next one Bullfrog below Hanson Creek. At Jocko Rapids had a man get out and wade and lead the boat and feel his way to find the channel. Wintertime and river very low. Bed rock runs clear across the river and is full of potholes. Next rapids at mouth of Escalanta River. Aztec Rapids below the mouth of the San Juan, one of the worst on river between Hite and Lees Ferry. Last Chance Rapids at the Crossing of the Fathers, very near the Utah-Arizona Line. (R. 3610–3611.)

Sand bars were encountered, especially below the mouth of the San River.

Water low and bars not moving. In the still places there would be big bars.

The trip upstream with big launch was a hard trip. Would not go upstream under its own power. Had 13 men and it took 26 days to get launch up. Engine worked all right, but the water in river was fairly swift and engine could not propel upstream against the current. (R. 3612, 3613.) Necessary to tow past all of the rapids.

From Hite to Tickaboo, generally went down on horseback. Has gone in a boat, and also on foot. If boat not handy supplies were taken down with pack animals; particularly in high water, because of dangers with rocks, whirlpools and sand waves. (R. 3616.)

When he arrived at Hite, population between Crescent Creek and Good Hope bar was possibly 30 to 35 men engaged in placer mining. From Good Hope bar to Hall's Crossing people strung along the river. (R. 3616–3618.)

Mr. Stanton had from 50 to 75 men at the dredge or on the road.

During all the time he was in there never knew of supplies being brought down the river from Greenriver. (R. 3618–3619.)

Materials for dredge freighted in with teams from Greenriver, coming down to river by way of Hanson Creek. (R. 3620.)

Boated some supplies down to the dredge from the point on river where they were unloaded from wagons. Used keel bottom rowboats, good boats for rough and dangerous water, but drew too much water for shallow rapids. (R. 3621.)

Boats were operated over whole river between Stanton's operations and Lees Ferry, mostly around Good Hope Bar and around Hanson Creek, with the exception of coming back up river, which they did only by dragging boat up over the rapids. (R. 3621–3622.)

Going up to Hite boats were rowed, but where there was a good deal of water, got out and pulled the boats by shore line. (R. 3623.)

Between Hanson Creek and dredge no rapids and water comparatively still. (R. 3624.)

Scow operated over distance of less than half a mile.

Section of river between North Wash and Hanson Creek, sand bars most everywhere along the river, but that section tolerably free, because there is more swift water from North Wash down to Bullfrog Rapids, than any one place in the large Glen Canyon. (R. 3625–3626.)

In that section of the river between North Wash and Hanson Creek, they encountered rapids. There was sand bars along most everywhere in the river, but not there, that was tolerably free, because from North Wash down to Bullfrog Rapids there is more swift water than any one place in the large Glen Canyon; they call that Glen Canyon from there to Lees Ferry. (R. 3625–3626.)

The different stretches of water in the river caused rearrangement of the sand bars in the bed continually; the channel changing during summer floods, and after every high water, particularly, when water came from side canyons, such as Trachyte and White Canyons and Crescent Creek and it would deposit large quantities of silt and sand in the channel. He noticed different channel changes nearly every time he went up and down the river in a boat. He did not note these changes as being daily or weekly, because it was a continuous change, the sand working and rolling all the time. (R. 3626.) Of course, at times it moves faster and there is more of it; but each year the water will boil up, and it will crack in the night. He has been on the shore camping at night, and heard the water boil there for a little while, and then

it would be still, and after a while it would come again. By that he means the water just comes up like boiling water. It just comes up and is cracking and exploding almost; he never saw it in that part of the canyon, only in high water, on one trip he made to Lees Ferry. They called it sand waves, and he believes it was, because the water was so thick that you could pretty nearly step on it. It made a heavy roll; sometimes the waves would start rolling, maybe not more than a foot high, and they would keep on increasing until they would get up four or five feet, and then level out again. And it would start with these boils coming up, that have capsized boats. That is the way Mr. Frank Brown was drowned. (R. 3627.)

He and a man named Gibbons had a ranch at Hite that they cultivated and irrigated with water from Trachyte Creek. He commenced farming in 1905 and stayed there until 1914. In that time he did not notice any changes in the banks to speak of at his farm. Water for the farm was obtained by damming Trachyte Creek and conducting the water through ditches.

He had difficulty with ice once on the river, and has seen flow ice jam in the gorge and then freeze, causing much difficulty. (R. 3628.) He has noticed these ice jams between Hite and North Wash, and between Tickaboo (Rapids) No. 2 and Good Hope. This condition happens nearly every year.

He has done some boating on the Green River, having been down to the mouth of the San Rafael

from Greenriver [Utah], and once below the mouth of the San Rafael to a place he thinks is called Bowknot Bend. (R. 3629.) The purpose of this trip was just to see the country and he was accompanied by another man. He had a light rowboat, and carried nothing but provisions. In coming back up the river, he rowed and pulled the boat up.

He also made a trip up the river from Greenriver [Utah] to the mouth of Price River, with some engineers, for the purpose of surveying a dam site.

He has seen a good many floods on the Colorado River in and around Hite. The usual high water, or spring run off, occurs from the first to the twentieth of June, but the floods occur in the latter part of July and August, and are caused by cloud-bursts. (R. 3630.) At Hite during low water, there is quite a bar or island generally in the river, but in extreme high water the island is entirely covered to a depth of approximately twenty feet.

There is a road out from North Wash on the west side of the Colorado; the last work he did in that country being to help build that road from Hite. The Trachyte Road had to be abandoned because of destruction caused by floods. The road from Hite to North Wash was on the west side of the river. There is no road from Hite down to Hanson Creek on either side of the river. (R. 3631.) It is possible to get from Hite down to Good Hope Bar with a pack train, but below there the wall rock comes down to the water, and in extremely low water only has anyone

ever been able to do down to Hanson Creek, even on foot. It is possible, however, to get from Hite down to Hanson Creek with a pack train by going up Smiths Fork, climbing up on the mesa and coming down to Hanson Creek. There is shallow water at Dandy Crossing in the winter, and he has ridden a horse across there. Dandy Crossing is a regular crossing used by travelers, and there was a ferryboat there most of the time he was in that country. (R. 3632.)

Cross examination (R. Vol. 20, pp. 3633–3638):

At Lees Ferry he spent three or four days working on an engine for Mr. Stanton. He did not know what the trouble with the engine was. They got it to running, however, but it didn't have sufficient power to run against the current. (R. 3633.) After they got started on the trip, it did not run at all.

And he had to pull this big motor boat the entire distance up from Lees Ferry, practically; Mr. Stanton hired some extra men and they rigged oars and rowed it where they could, but every bad place they had all hands to get on the line and pull it. So that it was rather a "white elephant" on their hands. Would not say the motor would not run, because he did see it running, but it simply did not have the power to pull itself up. (R. 3633–3634.)

The motor would run because he saw it run at Lees Ferry, but after leaving there they did not try to run it. (R. 3634.)

During the placer boom on the San Juan River, some of the placer miners came down on the Colorado and spent some time on the bars there.

One or two parties came up the Colorado as far as Hite in small boats. A man named Mendenhall, who said he had come from Bluff down the San Juan, took a boat up, but he didn't take it away from Hite, as it was worn out. (R. 3635.)

Redirect examination (R. Vol. 20, pp. 3639–3645):

He was last at Hite in the spring of 1915. At that time there were only a few men there doing some work, including Frank Orr, Bert Seaboldt, and Mr. Shaw.

When he made the round trip to Lees Ferry, Jeremiah Johnson was with him when he came back, and they had four or five boats; he doesn't remember exactly. (R. 3639.) There were thirteen men in the party. This trip was in December, 1898.

One trip that he made to Lees Ferry and came back overland was in 1909 and 1910, when he was accompanied by a man named Turner. In going down the river, he used a very good boat that was given to him by Mr. Stone, who stopped at Hite after coming down the river from Greenriver, Wyoming. (R. 3640.)

Another trip was made, he thinks, in 1905, with Fritz von Wyschuhn, using boats that were shipped in from San Francisco; very much the same type of boats as the other keel bottom boats. Mr. Wyschuhn, at that time, was relocating the property of Mr. Spencer at Lees Ferry, after having had wonderful reports of his operations there. That must have been in 1912. (R. 3642.)

The boats used for the Wyschuhn trip were brought in to the Colorado from Greenriver [Utah] with wagons, by way of Hanksville and North Wash, and were put on the river at the mouth of North Wash. There were three boats; and as he remembers, ten men in the party. (R. 3642.) Others of the party whom he remembers were J. W. Wilson and William B. Hay. The trip was made during high water, and very little trouble was encountered on the way down, the only stops being made were for the purpose of making locations; and he thinks they could have made the trip in two days' continuous running. But they had no accidents, only in these big sand waves and sand bars; you would get into those sand waves, some of them, and if you did not handle your boats just right they would capsize, and in that heavy water he knows Mr. Wyschuhn was excited several times. (R. 3643.) The boats used were not decked over, except a little in front and rear, but not water-tight. (R. 3643.) The Julius Stone boat, which he had, was partly decked and had water-tight compartments in it. The other trip was made after the high water peak, but there was still plenty of water to boat down in.

He met Mr. Spencer at Lees Ferry, and Spencer was working a kind of dredge for working the silt from the bottom of the river. At that time Spencer had a big steamboat up at the mouth of Warm Creek, with which to haul coal to run his mud machine. (R. 3644.) He did not see the boat in operation; it

was tied up there [at Warm Creek]. That is the only time he ever saw the boat. (R. 3645.)

Recross-examination (R., Vol. 20, pp. 3645–3647):

He did not stop at Warm Creek, but saw some coal there, although he could not see how much; there may have been a ton or more. (R. 3645.) The coal he saw was lying upon the banks at the mouth of Warm Creek. He believes they call it Rock Creek. (R. 3646.) He did not get out to investigate the coal; and did not see any large piles of it.

On the Turner trip, Turner took the boat back up the river, and he, Hite, went on to Flagstaff. The Wyschuhn boats were left at Lees Ferry. He was employed by Wyschuhn as boatman.

After the Turner trip, he went overland from Flagstaff to Daggett, California, and then to Salt Lake City. (R. 3646.) He saw Turner after that at Hite, and he had the boat there with him. (R. 3647.)

LESTER A. SHAW

For Complainant

(Record, vol. 20, pp. 3649–3674)

Lester A. Shaw of Kingston, N. J., sales engineer for the Lehigh Coal & Navigation Company, was in and about the Colorado River in Utah, in 1914; at that time being interested in some uranium claims on the San Rafael, about 15 miles south of Greenriver, Utah, on the west side of the Colorado River. The claims were about 5 or 10 miles up from the mouth of the San Rafael. (R. 3650.)

Equipment for operating the claims was taken in by wagon from Greenriver (Utah) to the San Rafael. He was there a matter of a few months, and then did some ranching on a small ranch about 5 or 6 miles north of Greenriver. The ranch consisted of 25 or 30 acres of fruit, about one-half mile back from the river, and was reached by wagon road. He never used the river for the purpose of reaching his ranch, which was subsequently abandoned. (R. 3651.)

About that time he received employment from the Government as boatman for the Reclamation Service in the year 1914. Previous to this time his only experience in boating was with canoes, rowboats, and motor boats in the east. The Government party with which he was employed was under the charge of John F. Richardson. He (Shaw) was hired on a salary and also to furnish the boats. (R. 3652.)

He used a power boat 14 or 16 feet long, named the *Belle of Shannon*, which would draw 4 to 8 inches of water, empty. It was equipped with a two-cylinder marine engine, fixed permanently to the boat. The boat was purchased from Capicki. (R. 3653.) In getting the boat the party had gone ahead. The boat party was to meet up at Wimmer's Ranch, and he launched it at Greenriver; left with the boat at Greenriver, the *Belle of Shannon*, and went down from there to Wimmer's Ranch, where the freight and equipment had been loaded on the larger barge, and left with the party from there. Between Greenriver and Wimmer's Ranch, he encountered difficulty

in taking this boat down there; particularly as he was alone and knew nothing of the river and had no experience there; and the things that stand out most in his mind are the rocky riffs, which he had heard about and had been warned about, and which were more serious than sand bars. However, frequently he would get into a wrong channel of the river, and would have to get out and push. And he remembered occasionally going over a harder substance, which might have been a boulder, or a rock riff; he did not look to see; he was simply worried as to whether he had gone over or had torn a hole in the boat; it was a solid substance. But he was very happy to arrive at Wimmer's Ranch, because that part was all new to him and it was a new experience. (R. 3653–3654.)

When he arrived at Wimmer's Ranch the equipment was already there and loaded on a barge ready to go down the river. (R. 3654.) There was also a small motor boat there in charge of Tom Wimmer. From there, after loading the boats, they went on to the junction of the Green and Grand (Colorado) Rivers. Trouble on the trip with sand bars was encountered continually. He discovered that the sediment formed sand bars very quickly and that it was necessary to find the right channel. This was made easier for him because the other party was ahead most of the time and picked out the channel. Regardless of that, however, he would get stuck with his boat, and on occasions got out and helped the larger boat, which in places got stuck regardless of piloting. This hap-

pened where there might be one or two channels in the river, and they picked the wrong one, and would have to go back to the other. (R. 3655-3656.)

By the larger boat he means the scow with the equipment on it. The *Marguerite* was the scow that pushed the equipment down, and the *Betsy Ann* was originally purchased for the Government. (R. 3656.)

As he remembers, the scow preceded him, the *Marguerite* being the power behind the scow. He would say that sand bars were encountered two or three times a day; some days more than others. The sand bar was an entirely unknown quantity, occurring at intervals, according to the nature of the river. (R. 3656-3657.)

After reaching the junction of the Green and Colorado Rivers, he remained until the work was completed, with the exception of two or three trips he made out. (R. 3657.) One of these trips was up the Green River, and two up the Grand (Colorado) River to Moab. He does not recall how far up the Green River he went. Difficulties encountered between the junction of the rivers and Moab were similar or possibly worse than those encountered on the Green; the sediment in the river being worse. The rapids were more frequent. The last trip was worse because it was taken soon after flood water, which made it the most dangerous trip he had on the river at that time.

The first trip to Moab was to take W. S. Steele, who falsely represented himself as being a representative

of the government. Another member of the party made the trip with him. (R. 3658.) The other trip was made by Mr. Sawyer and himself, after the outfit had been affected by the flood water. (R. 3659.)

The reason why the drilling at the junction was ceased was because the flood waters came down and destroyed the drilling equipment that they were drilling with, and the drill went down the river, and it was necessary to cease. (R. 3660.)

He has had some experience in smelters, mining, and civil engineering. (R. 3660.) He has never been in charge of drilling operations, never having done any drilling outside of his work with this government party.

The drill was anchored on barges in the center of the river when the flood waters came on the occasion; the débris coming down with the floods broke the barges, the casing that they were drilling through with the diamond drill; the barges were washed down the river on the side of the bank, on the right-hand side going down; and the diamond—not the drill part—was recovered, but it would seem that the casing that was down in the ground was lost. But the flood waters bringing down the débris from upstream is really what caused the casing to be broken off and lost. (R. 3661.) After this occurrence the outfit was taken out, the steam boiler and drill being equipped on one of the barges, and the paddle wheel geared to it and used as power to operate the boat. The *Marguerite* was used as power on the other barge, and he came

by himself in the other motor boat, which was attached to the other scow. (R. 3661-3662.) Encountered sand bars, more frequently than coming down; it was naturally a harder trip, being upstream. But after the high water they had had the sand bars had changed their position, and even the larger landmarks that he tried to remember were removed, and the ones the older members of the party remembered were removed. Of course, there were such places where there were permanent landmarks along the bank, but the channel of the river had been changed in a great many places, and he remembers distinctly being amazed at how they had been changed in places. There were places that were high places when they came back that were covered with water when they went down. But the high places were more easily avoided, jumping around upstream, because if you found a bar it was easy to work backwards and get to the channel. However, there were places where they had to get out and pull and push. (R. 3662.) Boats were tied up to shore at night. He made observations as to the effect of the sand upon their boats when they were tied to the shore; they tried to get as secure and safe a place as possible. There were occasions when, during the night, while precaution was taken as much as possible, the sand would wear away or build up around the boats occasionally. The sand was very shifting, of course, and at different stages in the water, except at high water, they did not know what to expect, and they were either settled into a bar, or it would move and dissolve very quickly.

Oftentimes it would move in the night; there would be an abutment of the bar that would dissolve away very quietly until, possibly, the other portion of it would break away. But there was no rule or regulation to go by. It was simply just doing the best they could. (R. 3662–3663.)

On the trip up the heavier equipment was unloaded at Wimmer's Ranch and freighted out, some of the personal supplies and the men going up the river in the smaller boats. He can not say exactly where they left the boat. He remembers that with two men in the boat with him they pulled to where they could not run the motor because of the propellers, and when they got tired of pulling it they left it there and walked the rest of the way [to Greenriver, Utah]. He thinks the boat was loaded onto a wagon and taken to Greenriver, where he disposed of it He was paid wages by the government for the services of himself and boat. (R. 3663–3664.)

Cross-examination (R., Vol. 20, pp. 3664–3671):

The boat he left three or four miles from Greenriver was purchased from Captain Yokey. He does not know what became of the *Marguerite,* and does not know if it got to Greenriver on that trip. He thinks it did not, because he talked with the occupants of the boat when they got in. (R. 3665.) He does not remember to whom he talked. He was in the hotel when they arrived and knows there were some wagers as to who would get there first. He does not know, of course, what happened to the

Marguerite or what the *Marguerite* did outside of his vision. (R. 3666.)

He does not know the location of the Shafer No. 1 Well, and has not been on the Colorado River since the two trips mentioned, from the junction of the rivers to Moab. (R. 3667.)

From his observation, the navigation on the Colorado up to Moab was more difficult than on the Green. (R. 3668.)

From the fact that he walked the last three or four miles into Moab on those trips, would indicate that from the point where he walked was where they encountered the greatest difficulty. (R. 3668.) On the other trip into Moab he thinks they pulled closer to the town. On the first trip he got to the place close to the bridge, where the supplies were loaded, and took them back to the river. Difficulties were encountered on the river on that trip before they stopped at Moab. (R. 3669.) He has no recollection of the particular places where trouble occurred, and would not say that the most serious troubles in navigating occurred in the last 10 or 15 miles on either of the trips. (R. 3670.) The last trip was taken under different conditions. There had been a flood on the river, and the débris, and so on, in the deeper canyons in the mouth of the river made it harder to navigate it. It was necessary, however, to navigate it, because they had to get father up the river. When they got within four or five miles up the river it was unnecessary to make off, and when they got there they landed the boat and walked the

distance. But it is certain that the difficulty at the mouth of that river was greater than it was up the river, on the second trip. That was because of high water and débris floating down the river. (R. 3670–3671.)

He does not know that the most difficulty was encountered at a place called the "Slide," but it was a few miles above the confluence of the Green and Colorado Rivers. At that time the water was very high and rough in places. (R. 3671.)

Redirect examination (R., Vol. 20, pp. 3672–3673):

Complainant's Exhibit No. 477 is identified as a photograph taken at the junction of the rivers, showing the *Belle of Shannon*, Mr. Anderson's boat, and the paddle wheel geared to the boiler. The picture was taken just as they were coming up [the Green River]. (R. 3672.)

Recross-examination (R., Vol. 20, pp. 3673–3674):

The loss of the drill and other equipment was the result of high water, causing heavy débris to collect around the anchor cable and the barges, causing them to give way with the weight. (R. 3674.)

JOHN F. RICHARDSON

For Complainant

(Record, vol. 20, pp. 3675–3728)

John F. Richardson of Huntington, West Virginia, is a civil engineer in the Engineer Department At Large of the War Department, and has followed his

profession since he left college in 1897. He is a graduate of Tulane University and has done special work in connection with rivers, that having been his work practically all of his professional career. (R. 3675-3676.)

He has had river experience on the lower Mississippi, the Calcasieu throughout its length, the Atchafalaya, from its head to below Melville, Louisiana; a number of rivers in the west with the Reclamation Service and has done some work in South America, Chili, Mexico, and on the tributaries of the Ohio River in West Virginia.

In his work he has dealt with irrigation, flood control and navigation, having had charge of irrigation work of the Reclamation Service on the Colorado River and its tributaries.

He first came to the Colorado River in 1914, at that time having charge of the investigation of the Green River from its junction with the Colorado up to Castlegate, Utah. (R. 3676.)

He had charge of the investigation of the rivers—the Colorado River from the junction of the Grand and the Green, up to Castle Gate, in Utah—up to the Palisades, in Utah, and the Green River, from its source, down to the junction, and then the Colorado as far south as Lees Ferry, Arizona; and some other tributaries of the Green River, the Yampa and the White and Vermillion and Sandy, and some of the other tributaries. Also the San Rafael and the San Juan.

He has covered the section of the Green River from the mouth of the Yampa River, near the northeast corner of the State of Utah, down to the junction with the Colorado River; on the Grand (Colorado) River from Moab down to the junction; the Grand (Colorado) River—the name is changed now. He has covered the Green River from—well, about its source in Fremont Lake, in Wyoming, down to Flaming Gorge, Utah, personally. And the Colorado River from Hite, Utah, down to Lees Ferry, Arizona. (R. 3676–3677.)

His object on the river from an engineering standpoint was to find a reservoir site that could be used for irrigation and flood control purposes.

He was first on the Green River from Greenriver, Utah, down to its junction with the Colorado, when he made a reconnaissance survey in June 1914. At that time he went down the river to the junction in a boat and back again to Greenriver, Utah, in the latter part of June, during the high water of 1914. (R. 3677–3678.)

By a "reconnaissance," he means that he went down to look the country over, and see whether the United States would be justified in making further examinations or surveys, by diamond drill borings at a dam site, and to take in the general character of the country and see whether it was suitable for a reservoir site. (R. 3678.)

At that time he concluded it would be a good thing to make investigation for a dam site just below the junction [of the Green and Colorado]. He used a

launch that belonged to Captain Yokey, the name of which he does not recall. He afterwards had two launches, one he thinks named the *Ritter* and the other the *Belle of Shannon*. (R. 3678.)

They had another boat there, an old piece of a boat, that belonged to Wimmer, Tom Wimmer, a stern-wheel; it seems to him they had that boat. But that first trip that he made was certainly in that boat that belonged to Captain Yokey. (R. 3578–3579.)

That boat was about fifteen or sixteen feet long, probably ten horsepower, and drew fifteen inches of water at the scupper line. He and Mr. Yokey were the only members of the party. He had with him some maps secured from the War Department or the Survey that were secured in 1909, a copy of which he has with him. Compl. Exh. marked No. 480, entitled "Plan of the Green River, Utah, United States Engineer's Office, Los Angeles, May 19, 1910," was one of the maps which he used on that occasion. (R. 3679–3680.)

The Geological Survey had made the original map, and when Lieutenant Leeds had undertaken this investigation he used this as a basis for his maps. Those were based on Mr. Harrigan's original survey. And witness had used this map as a guide for his reconnaissance work.

Q. Now, take this map; take, for instance, right here [indicating] opposite Greenriver, it bears the imprint "H. W. 4059." What does that mean? (R. 3682.)

A. That means high-water elevation, 4,059 feet above sea level.

Q. Now, down here, in the neighborhood of the Auger, it says, "W. L. 4028.7, October 11, 1909." What does that mean?

A. That means the elevation of the water on October 11, 1909.

Q. And "H. W. 4043" means what?

A. That means that the high-water mark there and the elevation of that high-water mark, as shown by a mark on the stone, or by a distinct mark of some kind, that they have there, that it is that number of feet above sea level.

By the Special Master:

Q. "W. L." means the actual water level at the time of the survey, and "H. W." means the high-water mark?

A. High-water mark.

Q. As seen or observed by the surveyor, irrespective of the time when he was making the survey?

A. Yes, sir. In other words, when a hydrographer is looking for high-water mark, that is the best information that he can get. (R. 3683.)

Purpose of using map was that he wanted to find some visible way of getting down to the junction of the Green River and the Grand (Colorado) River, in the event that they found, or that he found, a good prospect for a dam site, and the question was how he was going to get down there. He had gone down rivers in boats: and had gone down rivers in pack trains, and walked

down; but this seemed to him to be a very difficult place to get into; and he wanted to see. He took this map down to see whether there would be a chance of sending a survey party down there with a boat, so as to make a survey of that site, and if the thing looked feasible, they sent a diamond drill outfit down there. (R. 3682-3684.)

He gave attention to the various indications of high and low water mark and carried a hand level with him, and checked up on a number of the marks on the trip, to satisfy himself on the general accuracy of Lieutenant Leeds' figures in various places, and came to the conclusion that they were reasonably accurate for his purposes. He also used Complainant's Exhibits Nos. 481 to 491, inclusive, being particularly concerned about the various riffles in the river. (R. 3684.)

Lieutenant Leeds had made a detailed survey of them, so that he consulted these maps as he went down the river and compared them with conditions on the ground, in order to make up his mind about the best way of getting his survey and diamond drill outfit down.

So far as he was able to judge the maps were reasonably accurate as to the character and location of riffles. He does not recall that they found any riffles in places for which he did not have a map.

His definition of a riffle is a shallow place in the river, where it might impede navigation, or it might impede a boat; the velocity is high and the water is shallow.

He makes no distinction between a riffle and a rapid, except that, perhaps, a rapid is considered a large riffle. (R. 3685–3686.)

He took soundings at a number of places between Greenriver [Utah] and the mouth of the San Rafael for depths, but does not recall what depths he found, inasmuch as it has been fifteen years since he made the survey. As he remembers, the boat grounded as they passed the mouth of the San Rafael, the propeller striking bottom or a rock; at that time the river was flowing some fifteen to twenty thousand second-feet [of water], to the best of his knowledge. (R. 3686.)

It was the latter part of June, 1914, when he left Greenriver, Utah, but he can not remember the exact date. (R. 3687.)

From the mouth of the San Rafael down to the junction with the Colorado River, they traveled quite rapidly. The river was very muddy, had narrow earth banks in places, some places talus, and other places cliffs came down to the river, and it was evident that in low water there would be numerous sand bars. As he remembers, sand bars were encountered on the trip down, the trip extending to a few miles below the junction of the river. He then returned to Greenriver, Utah, in a power boat. As he remembers, it took about a day and a half or two days to go down the river and four or five days to come back, though he could not be certain. (R. 3688.) As he remembers, sand bars were encountered on the trip up the river.

As he recalls, about the middle of July he made a trip down the river with Mr. F. L. LaRue, and right after that he took a drilling outfit down, the boats being built at Greenriver, Utah. He made a number of trips down, two or three, he does not just remember. (R. 3430)

He did not go down with the drilling outfit, he sent it down with Kenneth Sawyer. He helped load the outfit, however, as he remembers, and it was loaded at Wummer's Ranch. He did not take the outfit from Greenriver down to Wummer's Ranch, because the water was too low, and he had learned from experience that in order to get the drill down at all, it would have to be hauled part way by wagon. So he had the drill unloaded at Floyd, or a station by some such name, and had Wummer haul it out to his ranch at the mouth of the San Rafael, where Mr. Hiser organized a crew, loaded the boats, which drew twelve to fifteen inches of water, and sent the outfit down the river under Mr. Sawyer's charge. (R. 3430-3431)

Floyd is a station on the Denver and Rio Grande Railroad between Thompson and Greenriver, and there is a road between there and Wummer's Ranch, although not a good one. (R. 3431)

After the drilling outfit was installed at the junction of the rivers, he made several visits there to see it. He remembers on these visits that the river had a shifting, unstable channel, and it was a very dangerous place to take a drilling outfit and crew down. Rel

rock lay very deep under the fine sand bottom of the river, and when rise in water came the river bottom would scour, velocities increase greatly and make it dangerous for a drill crew at the junction. (R. 3692.) With every change in discharge of the river, sand bars would form on one side and wash out on the other, and on one stretch of the river, a short distance above the junction, it seemed to him on one trip that the whole bottom of the river was moving out. The Colorado River had fallen rather low, but there was still a fair discharge in the Green River, so that he and Captain Yokey had quite a time getting the first five or six miles up the Green River, to the junction. (R. 3692-3693.)

Sand bars had no effect on the drilling, but the movement of sand bars constituted a source of danger at all times, inasmuch as the whole bottom of the river might move down. The gradient of the river was about a foot and a half to the mile. (R. 3693.)

He was not present at the time the drilling outfit was washed away, but received word by telegram from Mr. Sawyer, and after consulting with his superior officer, he ordered the outfit moved out. He was not present when the outfit was moved out but thinks he was present at the time it was brought up to Wimmer's Ranch. (R. 3694.) At any rate he saw the outfit at Wimmer's Ranch but was not present when it was moved from Wimmer's Ranch up to Greenriver.

During the same summer he had the drilling outfit at the junction of the Green and Colorado Rivers. He boated between the junction and Moab in a sixteen-foot launch, operated by a man named Anderson; the launch, as he recalls, drawing about fifteen inches of water.

He made several trips up the Grand (Colorado) River from the junction, but only one, as he recalls, through to Moab. (R. 3695.)

That stretch of the Colorado River was essentially the same as the Green River, although the current is a little swifter, as he recalls it. The water, if anything, carried more suspended matter.

He has a very vivid recollection of the "slide" a few miles above the junction, which was a serious obstacle to navigation. He thought it would be necessary to line the rapid, but the boat went through under its own power.

As he recalls, difficulties were encountered on the trips up and down that part of the river, but he is not perfectly sure of it.

In the fall of 1915 he was on the lower Colorado River, from Hite, Utah, to Lees Ferry. (R. 3696.) He went to Hite from Greenriver, Utah, with a team, by way of the Henry Mountains, and trailed down a wash, the name of which he does not recall.

As he recalls, he had a boat that was obtained by Mr. Wimmer, who accompanied him on the trip. The boat belonged at one time to a man named Stone, who had left it at Hite, as it had been wrecked.

The purpose of the trip was for locating a feasible reservoir and dam site on the river. He does not recall the names of the sites considered, but one of them was possibly a site at Lees Ferry. (R. 3697.)

A great number of troublesome riffles and rapids were encountered on the trip from Hite down to Lees Ferry. Does not remember names of them. He remembers crossing one at the mouth of the San Juan River, and the river being so full of mud that their boat, which leaked very rapidly, stopped leaking because the water was so muddy, and he got out of the boat, and put his foot down, and he thought they were going on a rock; he put one leg out of the boat, and thought he was stepping out on a rock, and he went down almost to his neck, and found he was in a moving sand bar—the thing was just moving down the river. And there were a number of other places. (R. 3698.)

So far as you know, do you know of any other river in the United States similar to the Colorado River which is being navigated commercially? (R. 3698–3702.)

The SPECIAL MASTER. I would like to make an addition to my ruling on that question, so that you may have no misunderstanding.

Mr. BLACKMAR. Yes.

The SPECIAL MASTER. I would say that, if he knows of no river similar to the Colorado, it necessarily follows that he knows of no river similar to it that is operated commercially. (R. 3702.)

Q. Mr. Richardson, in making the examination of a river for the purpose of determining its usefulness, say, first, for navigation, what elements do you take into consideration? (R. 3702.)

The WITNESS. Well, you take into consideration the question of fall of the river, the probable velocity during high water, and the depth of channel and stability of the channel, the tortuousness of it. (R. 3703.) The obstructions that there might be in navigation, in the way of boulders, rocks, tree stumps. (R. 3703.) And the stream flow, particularly if the river is required to be moved by a slack-water dam. And the character of the bed itself—whether or not there was foundation suitable for the construction of locks and movable dams would be a very important element in it. (R. 3703.)

The fall of the Green River for about 30 miles below Greenriver, Utah, is about 3 feet per mile; and about a foot per mile for the rest of it. (R. 3705.)

The Green and Colorado Rivers are very tortuous, or crooked, for a great number of curves of short radius endanger navigation, especially when the current has considerable velocity, it having a tendency to throw boats against a bar, a cliff, or a rock. (R. 3706.)

The fluctuations in stream flow also affect the question of navigation very much. Dependability of flow is what affects it. (R. 3707-3708.)

The conditions he found in that respect on the times that he was personally there he saw the Green River a number of times, extending over a number of months, possibly a year or more—a year or more.

During that period, he observed that the stream was one of irregularity and erratic regimen. (R. 3708.) Regimen means flow conditions. (R. 3709.)

According to his observation the navigability of the river with reference to bed conditions is affected in one of two ways: In the first place, in those places where they had no rocks, the river is very turbid, and generally speaking, contains numerous sand bars, which shift from side to side and change from place to place, so that that channel is not fixed or stable.

With regard to the rocks, or conditions of the bed, or with regard to these obstructions, it would affect navigation, too. Of course, such obstructions would have to be removed if they could be at reasonable cost.

And there are both conditions, in part, on both the Green and the Colorado Rivers, so far as my observation extends.

The SPECIAL MASTER: Just a minute. The witness has mentioned a thing that I want to ask him about. He mentioned, in answer to your question, Mr. Blackmar, some time ago, the various things which were taken into consideration regarding the navigability of a stream.

The SPECIAL MASTER:

Q. You, Mr. Witness, said nothing whatever about the possibility of the removal of obstructions. Do you not take that into consideration in questions in connection with the navigability of a stream?

As to what elements you take into consideration, you do take in that?

A. Yes, sir; and the possibility of removing obstructions within a feasible cost. (R. 3709–3711.)

In his opinion the obstructions mentioned could not be removed at a reasonable cost.

He also considered the Green River, north of Greenriver, Utah, examining and taking into consideration a site below Henry's Falls, known as the Flaming Gorge, a few miles below the Utah line [Wyoming-Utah line]. The site was surveyed in the winter of 1914–1915. (R. 3711.)

A drill was taken down the canyon on the ice and the site drilled. He also made two reconnaissance explorations of sites lower down, one at Ouray [Utah] and one above Greenriver, Utah, known as, as he recalls, "The Searles" dam site. (R. 3711–3712.)

E. C. LaRue made two or three trips with him in a boat, but he does not remember the dates. They went from Green River, Wyoming, together down the Green River to Horseshoe Canyon; and another trip from Greenriver, Utah, down to its junction with the Colorado. (R. 3712.)

They also made another trip with Mr. LaRue, acting as topographer, from Hite, Utah, down to Lees Ferry, Arizona; and another trip was made from Moab down the Colorado River to its confluence with the Green River.

Complainant's Exhibits Nos. 481 to 491, inclusive, offered and received in evidence. (R. 3712).

Cross-examination. (R. Vol. 20, pp. 3713-3721):

Compl. Exh. Nos. 480 to 491, inclusive, are identified as being part of a report made in 1910, by Lieutenant

Leeds, representing the War Department, pursuant to an Act of Congress or a Resolution of the House of Representatives. (R. 3713–3714.) He had with him the report of Lieutenant Leeds to which he referred when he made the reconnaissance survey spoken of. (R. 3715.)

Compl. Exh. No. 2, "Department of the Interior, Bureau of Reclamation, Colorado River Basin," was made partly by him and under his direction. (R. 3715.).

The coloration in red shows the area, approximately, that will be completed, by the level of the water when the reservoir is full, or the limit to which the water would be set back by the dam.

On the proposed dam site marked "Glen Canyon" the red discoloration extends back close to the junction of the Green and Grand Rivers. It means that the reservoir, when full, would cover that portion of the Colorado River, below the junction of the Green down to the dam site, and would eliminate the rapids in that section. (R. 3716.) But you must understand that the reservoir would be built for irrigation, for power, or perhaps for assistance in navigation somewhat, and that it would be drawn down, so that at the upper end of this reservoir the cataracts would still be there. In other words, this is a basin; this is a reservoir, and when it is full it would back up that far; but as it is drawn down here (on exhibit) the river channel would be recovered and would remain approximately in its original condition.

That is, if it was drawn down to the foot of the dam site. (R. 3716–3717.)

The purpose of making a survey of the dam site, marked in red, was essentially for irrigation, incidentally for power, and possibly to assist in navigation. (R. 3717.) In other words, those red daggers marked on exhibit "Power Site" mean utilization of the power in the stream in its natural condition; that and the utilization of the stream by virtue of increase of the low-water flow of this storage reservoir. (R. 3718–3719.)

The primary purpose of the dam site, indicated on the map, is for the storage of water to be used in the Imperial Valley or in the lower end of the river and not for use in Utah or Arizona. (R. 3719–3720.) To be used for irrigation at a far distant point. And also at that time there was some talk of the question of navigability of the lower end of the Colorado, and the necessity for diverting the water out for irrigation purposes, and supplying that water from stored water; because, under the Treaty of Guadalupe Hidalgo, there is something in there about retaining the navigability of the lower end of the Colorado river. (R. 3720–3721.)

Redirect-examination (R., Vol. 20, pp. 3721–3722):

The map which is in evidence, Compl. Exh. 6, indicates that the elevation at Lees Ferry is 3,120 feet; under the head of the cataracts it is 3,800 feet. The head of Cataract Canyon is 3,800 feet. So that the

water—the rapids in Cataract Canyon would not be wiped out until the elevation at Lees Ferry attained a height of 3,800 feet.

These dams are not maintained full at all times. They are irrigation dams, because the need is a need for irrigation. The same thing applies to power, too: On some streams the irrigation need and power need are coordinate; and that is generally true with regard to the Colorado River. (R. 3721–3722.)

Recross-examination (R., Vol. 20, pp. 3722–3728):

The plan was to furnish water for irrigation of California lands, and, perhaps, Mexico, and Arizona lands, too, were in the project. The power was not designed to be used in California. The power, of course, would be generated at these local dams. That would be available to whatever extent it could be transmitted.

He has not been talking to Senator Johnson about that very recently.

He believes Utah would get a cut of it too. They had a reservoir at Dewey there, and another one up there at Ouray, and they talked about the one at the Junction, which is not shown on this map. At Flaming Gorge, also, which is also in Utah. They were all very much interested in that—the people in Utah; the Governor of Wyoming, now Senator Kendrick—they were all very much interested in it as a power and an irrigation proposition. (R. 3722–3723.)

The distance water would be backed up would depend on the height of the dam. To the best of his knowledge and belief, power is an incidental feature to the Boulder Dam project. (R. 3724.) He does not know, of his own knowledge, that it is contemplated that the water behind the Boulder Dam shall never fall more than fifty feet below the top of the dam.

Q. Well, as an engineer, would it not appear to you as desirable that only sufficient available capacity be left to take care of some emergency flood?

A. Well, in case of Boulder Dam I would like to answer the question Yes or No, but I can not. I think in case of Boulder Dam that there is a question there of a large amount of silt that is carried by the Colorado River, and the necessity, in view of the large expenditure that the Government proposes to make there, of reserving space at the reservoir, so that it will not fill up with silt, because undoubtedly the rate of filling will be very rapid. That capacity certainly ought to be sufficient to give you the volume of storage that you require for whatever purposes you are building that dam.

Now the main purpose may be irrigation or incidental power, or it may be power, and if it is solely for power, the question will come in as to how that power is to be used. Sometimes the power is more valuable than it is in others. So that you would have to figure that thing out, having your full head and your full reservoir at the time your power was worth most.

If irrigation was the essential need, why, when growing crops needed the water, you would have to figure that you would have the water there as well as you could figure, sometimes they make mistakes about those things, and engineers get in trouble about it. (R. 3726, 3727.)

He is not sufficiently familiar with the Boulder Dam or the Lees Ferry Dam to say what height of water is to be maintained behind them.

Unless the general conditions were to be as indicated on this map (Exhibit 2), that is, the red showing the extent to which the water was to be set back, he does not see why they are colored red, that is, he should have assumed that this map meant that a dam site, for instance, at Glen Canyon, would set the water back as far as it is shown on the map.

A. That is a misunderstanding, Your Honor, that this map is generally a picture. It does not pretend to be precise, with regard to its delineation, or delimitation. Within the limits of that reservoir, I think that the draftsman who has worked on that has taken the topographic map and sketched this thing free-hand, so that the red area represents an approximation—a free-hand sketch, you might term it, of the area that might be flooded when that reservoir is full.

Q. In other words, that is the maximum extent to which such a dam site might set the water back?

A. Yes, sir; you said it better than I could say it myself. (R. 3727-3728.)

HUGH D. MISER

For Complainant

(Record, Vol. 20, pp. 3728-3758; Vol. 21, pp. 3758-3794)

(Record, Vol. 21, pp. 3881-3882; 3901-3903)

He resides at Washington, D. C., and is a geologist by profession, in the employ of the United States Geological Survey. He is a graduate of the University of Arkansas, having obtained a B. A. degree in 1908, and a M. A. in 1912. Since that time he has followed his profession as a geologist, most of the time being employed as a geologist by the United States Geological Survey, but for a brief period having been employed by the Arkansas Geological Survey. For a brief period of time he was professor of geology in the State University of Arkansas, and at the same time ex officio State Geologist of Arkansas. He was employed for a brief period as assistant by the Tennessee Geological Survey, and for a brief period of almost a year was State Geologist of Tennessee.

As one of his official duties he made an examination of certain portions of the San Juan River in Utah, examination commencing July 18th, 1921, and continuing until October 3rd, 1921. (R. 3728-3729.)

Subsequent to that time he prepared Water Supply Paper No. 538, entitled "The San Juan Canyon," by Hugh D. Miser, published in 1924. All of the essential features that might affect navigability on the San Juan River are set forth in that paper. (Water Supply Paper No. 538, Complainant's Exhibit No. 56.) (R. 3730.)

"The boats for the expedition [in 1921] were launched on the river about four miles below Bluff, under the directions of Mr. Trimble; he, Miser, being attached to the expedition as geologist, his official instructions being to examine the geological structure and oil possibilities of the region traversed and to also make a study of any dam sites under consideration on the San Juan River. (R. 3730–3731.)

At that time no dam sites were being considered on the San Juan, and the only site on the Colorado River below the mouth of the San Juan was the Glen Canyon site; for inasmuch as the proposed site of the dam at Lees Ferry was such as would raise the water in the reservoir to an elevation of thirty-nine hundred feet above sea level, it was not necessary to consider sites on the San Juan at that time. He felt it advisable, however, to examine all possible favorable sites on the San Juan for future consideration, in order that the information would be available. After his return to Washington he and Mr. La Rue went over the situation, picking out a lot of favorable sites and prepared to submit to the Geological Survey a report describing them.

The proposed height of the dam [in Glen Canyon at Lees Ferry] is seven hundred and eighty feet. (R. 3731.)

At the beginning of his trip on the San Juan River the boats were launched at a fairly steep place in the bank where the water was not very deep, and some of the party waded out in the river a short distance to

take a picture of the launch, the main current of the stream being away from the bank at that place. The water there was possibly a foot or two deep, according to notes taken by him. (R. 3732.)

From the point where the boats were launched all of the members of the party walked for a great distance, rarely getting into the boats; the depth of the water could be judged by whether or not there was trouble with the boats and also at times when it was necessary for the party to get into the boats, some of which times they would strike bottom.

The first place where difficulty was encountered was called The Narrows, and was caused by a rise in the river. (R. 3733.) No difficulty was encountered between Chinle Creek and The Narrows, the water being fairly swift; but the boats were kept as near as possible in the quiet water. The boats grounded at one place until after they passed the mouth of Moonlight Creek, where a portage was necessary, at a rapid at Mile 77.5. This rapid was filled with boulders and it was necessary to portage the equipment and let the boats through empty.

The first rapid encountered was at Mile 124, according to this notes. (R. 3734.) The boats went through this rapid without difficulty.

At The Narrows a swift current was encountered, there was a rise in the river, and the water was so rough it was feared the boats would be overloaded if the members of the party went through in them. He and Mr. Christensen climbed up the cliffs, and

upon getting through, built a fire as a signal to the others. It required almost a half day to climb over, and about noon the river had receded sufficiently for the boats to come through safely.

The water was so rough during that little flood flowing through The Narrows that the waves would throw water up and into the shallow boats, in their overloaded condition. Those boats had no water-tight compartments, and any water that would splash over the side would land in the boat. (R. 3735.) Had no trouble in grounding. (R. 3736.)

The mileage 77.5, where a portage was made, is from the mouth of the San Juan River.

In a rapid at Mile 82.7 the boat was cracked and nearly swamped because of striking a boulder. There were numerous little rapids all along. (R. 3736.) Most of the rapids are marked on a map contained in his report [Water Supply Paper No. 538, Complainant's Exhibit No. 56.] but the locations in miles from the river [Colorado] are not given on the map. (R. 3737.)

He does not believe he would make any distinction between a riffle and a rapid.

A rapid on his map is an especially swift stretch of water where there is a perceptible fall, and also where the water is fairly rough—much rougher than in the adjacent portions of the stream. (R. 3739–3740.)

After he had indicated stretches of swift water as rapids he would have to indicate the entire San Juan River. He did not use the term "riffle" but merely

used "rapid" and "swift water." (R. 3740.) According to his definition, as he uses the word "rapid" everything that he applies the name rapid to is a rapid. (R. 3741-3742.) Some people use the word "riffle" for a small rapid. He uses the word "rapid" to cover such things as that. He intends it to cover everything that is worse than real swift water. (R. 3742-3743.)

The first rapid, then, according to his definition, is at Mile 124. The next one, Mile 122.5, approximately. The next one about Mile 121.9. The next one about Mile 121.6. The next one about Mile 118.2. The next one just below the mouth of Gypsum Creek, at Mile 113.7, approximately. The next one at Mile 98.5. The next at Mile 95.2; next, Mile 94.7; the next, Mile 93; the next, 92.7. Also at the following miles: 89.1, 88.7, 84.6, 83.3, 82.7, 82.4, 80, 78.4, 78, 77.5, 76.9, 74.6, 71, 70.4, 21.5, 21.4, 21, 20, 19.9, 18.6, 16.8, 15.8, 14.9, 11.4, 10.9, and 10.6. That is all. (R. 3744.)

No rapids are enumerated between Grand Gulch and Piute Creek, a distance of fifty miles; and, according to Mr. Hoyt, the drop of the river in that stretch is five and one-half feet to the mile, and the difference in elevation between the two creeks is two hundred and sixty-six feet. (R. 3744-3745.)

Swift water would be the rest of the San Juan between the rapids. (R. 3745.)

The maps used by him and referred to were published by the United States Geological Survey, and

the positions of rapids superimposed on them were placed there by him after carefully reading over his personal notes, and from his recollection. (R. 3745.) These maps would conform essentially to the maps appearing in Water Supply Paper No. 538, Compl. Exh. No. 56.

He has mentioned all of the rapids, but he has not enumerated quite all the difficulties. (R. 3746.)

At Mile 77.5 there was a portage. Then one of the boats was cracked in the rapid at about 82.8. And then there was some water in the second Narrows. (R. 3747.)

Between 104 and 106, Christensen, Loper, and he started out from camp about 7.30 a. m., and followed one of these talus-covered benches to a point about two and a half miles below the place where we started. The further they went, the higher the bench rose above the stream, and also the further they went, the chances of getting down to the stream became so slight that they returned.

The three of them started down the river in the boat at 11.30 a. m., reaching destination about 45 minutes later but not without mishap. It all happened this way: From the camp Luke headed up to the left bank to avoid the swift water and to reach clear water. When they reached a certain place named 40-A, it became necessary to cross the stream to avoid swift water on the left bank. When they approached the middle, and were going toward the shore, sand waves began to form. They got higher and higher,

and reached as much as six or seven feet high. Blake hit them endwise. Finally, the boat hit a steep one and took water in. Hite took a can and began to bail. Blake says, "Hold your hat." He grabbed his hat and began bailing with it. Blake, who saw what was happening after they hit the first bar, said that water was coming in, and that this was the bar that would give us trouble. After the water came in, they were headed for the left shore, and the water had gotten deeper. Blake took one of the heavy oars and put it down in the water, and when they were almost to the left bank Blake said that the water was about waist deep. He jumped out, and then they followed. The water was bailed out and the leak in the boat was fixed. He got as much water as possible out of his clothes. (R. 3747–3748–A.)

Between Moonlight Creek and Piute Rapids the boats grounded in numerous places because of shallow water.

Those are the outstanding difficulties they encountered. (R. 3749.)

Between Moonlight Creek and Piute Creek the Channel of the river is fairly wide; the water spreads out in places and is shallow, so that the boat grounds quite frequently during the day. (R. 3749–3750.) It is a braided channel.

Q. That section that was just mentioned, between Moonlight and Piute, would that river as you saw it there be described as having a braided channel?

A. Between Moonlight and Piute the river would be braided in some stretches in low water. (R. 3750.)

No soundings were made between Moonlight Creek and Piute Creek, to determine the depths of the channel, but the boats would float if the water was in excess of a depth of about six inches. (R. 3750.)

There would be trouble with the boats grounding, of course, in six inches of water, and they were especially light. His only concern in getting the boats forward was getting out and wading and pulling them through shallow places, and when the water was only six inches deep or less, considerable difficulty was encountered in getting the boats forward. If the water was less than five inches deep it was necessary to carry the boats. This condition occurred in that stretch of the river between Moonlight and Piute, and it was necessary at one time, a few miles above the mouth of Piute Creek, to pick up one end of a boat at a time, and lift it around until they were in deeper water. (R. 3751.)

They picked up one end of the boat and carried it around to deeper water, and then picked up the other end, and carried it around to deeper water, and that process was repeated until we got the boat in deeper water. (R. 3752.)

In that particular instance the deep water was in front of the boat. It was necessary to drag the boat in a number of places, but he recalls only the one place where it was necessary to lift it around. Some days it was necessary to spend hours wading in the water and dragging the boats; on other days it would be unnecessary to spend so much time; but in that

section of the river, dragging the boats was a frequent occurrence. (R. 3152–3153.)

At the mouth of Piute Creek it was necessary to portage the supplies around the first two rapids and take the boats through empty. The boat he was in was nosed through two or three rapids below Piute Creek, and when they got to the thirteen-foot rapid it was necessary to portage everything. The thirteen-foot rapid is in Mile 11.4 above the mouth of the river. (R. 3753.) These are all of the rapids he recalls.

Between the point where he entered the San Juan River and its mouth it is possible to get out of the canyon at Goodrich and numerous places above Goodrich. Below Goodrich it is possible to get out at Mendenhall's cabin, Honaker Trail, Slick Horn Gulch, Clay Hill Crossing, and Zahn's camp. It is inaccessible between Zahn's camp and Spencer's camp for several miles in the Great Bend, and in the last ten or eleven miles below the thirteen-foot rapid. Aside from trails that come into the canyon at Mendenhall's cabin, Honaker Trail, and Slick Horn Gulch, there are trails entering at Piute Farms, Copper Canyon, Wilson Creek, Springs Gulch, and other places as shown on the map. (R. 3754–3755.) There is no settlement at Clay Hill, except a small stone building that was once occupied by sheep herders and cattle herders during portions of the year. (R. 3755.)

He experienced difficulty while there on the San Juan with floods. They were only small floods.

The gravest of them did not exceed a stage of six or seven foot. But when the river was in flood, in excess of about two feet, they did not row any boats on the river; they stayed off the river until the flood would descend. There was one place above, somewhere between Slick Horn Gulch and the Goodridge [sic Goodrich] Bridge that a flood came up one morning, about breakfast time, and several of the members of the party had to move their beds, to keep them from being washed away into the river. Of course, they were fortunately not in the river at the time with the boats. (R. 3755–3756.) This occurred in the month of August and the flood would pass in a few hours. A rise of the river of two feet would generally keep them off the river. The sand waves would be so bad that there would be danger of the boats swamping. (R. 3756–3757.) The sand waves were most conspicuous during the falling stage of the water.

On the trip they saw the inhabitants of Mexican Hat, about a half dozen people altogether, and they saw some Indians who lived in Piute Canyon about nine miles away from the river. These were the only persons they saw and none of them had boats on the river. He saw no boats on the river except the ones his party had. (R. Vol. 20, 3757.)

(R. Vol. 21, 3759.) While he was on the San Juan River he noticed channel changes in the river, especially at his camp near Clay Hill Crossing, when the main channel shifted from the middle of the river to the bank and then back to the middle

again in the course of a few hours. This change took place during a flood. (R. 3760.)

At Piute Farm, where the channel is a little over 3,000 feet wide, the main current would shift back and forth; it was observed to shift from some place near the middle of the channel over to the bank, and then back to the middle of the channel. And when the current was over next to the bank, a great deal of the bank was washed away. They estimated that something like 75 feet of the bank—there was a strip of land 75 feet wide that was washed away next to our camp. Then, when some of these changes were taking place at Piute Farms, the river did not flow with a steady current; there were what he would call "pulsations." They could look upstream and see a splashing wave coming down the river. This splashing wave was at the front of fairly deep water. When this deep water would come, the river would be about a foot higher than it would a few hours later. In other words, the river flowed in surges; on the crest of one of those surges logs would be transported downstream, and all the islands in the channel would be concealed; in the troughs between the surges, the islands would appear and the logs would mire in the sand. (R. 3760–3761.)

By the word "channel" he means the width of the river from bank to bank, and when he speaks of the current he means the deeper part of the channel. (R. 3761–3762.) He didn't observe the depth of the channel at that place.

They rowed down the channel in boats in places, in fairly low stages of the water, but not in flood stages. He remembers one particular day that there was a flood, and they wanted to go down the river in boats, but they stayed off the river, because the river was too rough. Other days, there was a time when Bert Loper and he went down the river in a boat, with very little load on it, and they grounded at numerous places. And then they towed the boat upstream and grounded the boat upstream. (R. 3762.)

They were grounded right at Piute Farms where the floods caused the main current to shift. He was camped at Piute Farms for a period of four or five days, but during that time he and Bert Loper had a made a short journey down the river past Piute Farms and then towed the boat back up through that particular portion of the river. The trip spoken of started near Clay Hill Crossing. They wanted to scout ahead to learn something of the amount of work required to survey below the canyon. They went downstream for about a half day, rowing in places, but the boat would ground some. At night they camped a short distance north of Nokai Creek. That was the farthest point down the canyon they went on that particular trip. (R. 3763.) The trip started at Mile 55.5 and stopped at Mile 44.6. The boat was towed back upstream the entire distance. The boat, he believes, did not draw over six or seven inches of water loaded with a light bed

roll each, frying pan, a few biscuits and some canned goods. (R. 3764.)

At Spencer Camp the current in the river would shift its position from the middle of the channel to the bank and cause the bank to give so that the camp and equipment were moved back on several occasions. The width of the river at that point he would judge to be three hundred or four hundred feet. These channel changes seem to occur regardless of the stage of water. Even between floods the discharge of the river appeared to change due to other conditions.

In the daytime when the wind was blowing and sun shining the river would fall several inches; at night it would rise a corresponding amount, and so far as he knows, there were no rains anywhere in the river. These changes in the river were noted with reference to the positions of the bank and with depths when they were out with the boats.

He and Mr. Loper made a trip upstream from the mouth of Piute Canyon to Spencer Camp, a distance of about seventeen miles, for supplies. (R. 3765–3766.) The water in the river was at low stage, and they towed the boat the entire distance, Loper having one end of the rope tied to the boat bow and the other at the side of the boat in such a way as to keep the boat so that the current flowed against the side and would keep it in water deep enough to float. He and Loper walked along on the sand bar as much as they could but most of the distance it was necessary to wade in the shallow, swift water.

They started to tow the boat upstream and averaged a mile an hour, it taking altogether fourteen hours to take the boat up. At all times they held on to the ropes so that in case they sank in the quicksand they would have something with which to pull them out, and quicksand was found in a few places. In places they found whirlpools that were not dangerous to tow the boat around but that consumed time. (R. 3767.) There were also a great many shallow places where they would have to scout around to find deep enough water to get the boat through.

In going upstream it is sometimes necessary to let the boat drop back a ways and move in over to one side or the other. These shallow places were in what you might call "crossing bars." The river is crooked, and the main current would be on the outside of a bend. (R. 3768.)

When the river would change its course because of a reverse curve, the water would shift from one side to the other or from the edge of the cliff on the side of one bend to the side opposite on the other and between these two stretches of deep water there would be a crossing bar, with shallow water in many places. In some cases these bars would extend clear across and in such places is where trouble with the boat would be encountered, because of grounding. In other words, there is no main channel in these places and the only way the depth of the water could be determined would be by wading across and noting

how deep the water came on their legs. (R. 3768-3769.)

They could get along fairly well in six inches of water, although the boat would ground some.

There were not a great number of places on that particular trip where they had to carry the boat around.

On the down trip they met Wesley Oliver, the packer at Spencer's Camp, loaded on some four hundred pounds of supplies, and went downstream; the trip requiring about five hours. Oliver had originally come overland from Goodrich with a pack train and was to meet them at Piute Creek, but was unable to reach there because the trail was blocked by a recent landslide. (R. 3769.)

From the launching place near Bluff, supplies enough were taken in the boats to last until the party got to Goodrich, the balance of the supplies were brought to them overland by pack train except on one trip that Bert Loper took from the thirteen-foot rapid downstream to the Colorado, and obtained grub that was cached there and brought back to camp, a small sack of flour. On this trip Loper had walked and waded the river whenever necessary, and arrived at camp that night with a wet sack of flour. (R. 3770-3771.)

They had received supplies at several places between Goodrich and the time when the packer was supposed to bring supplies in at Piute Creek. These supplies were brought down to the river on various trails.

He is familiar with a rapid known as Aztec Rapid on the Colorado River, and he would judge from the character of all of the rapids that he designated on the San Juan that they would all compare in size, and are worse than the Aztec Rapid. (R. 3771.)

After you reached the Colorado River, their mission had been completed.

On the trip down the Colorado River to Lees Ferry Oct. 5th to the 8th, no difficulty was encountered getting across Aztec Rapid. The boats went through easily, the only impediment to progress being groundings and shallow water on a few occasions; in fact, that stretch of the Colorado in comparison with the San Juan seemed like a very placid stream.

On the trip down LaRue, Kolb and himself acted as boatmen. Upon arriving at Lees Ferry he went overland to Flagstaff, Arizona.

He has observed a lot of silt in the San Juan River. The river was always muddy when they were on it. (R. 3773.)

In his opinion, the wind contributes only a minor portion of the silt and sand in the San Juan River, the greatest portion being brought down by side streams or water flowing across the surface of the ground. (R. 3774.)

Cross-examination (R. Vol. 21, pp. 3774–3790):

When he wrote Water Supply Paper No. 538, Compl. Exh. No. 56, he recalls the following statement appearing on Page 50: "The San Juan, in passing through the canyon, has numerous rapids,

though they are small, the greatest fall of a single rapid being only 13½ feet." (R. 3775.)

When he made the statement in his report "that these rapids are small" he had in mind as a standard, the rapids in Cataract Canyon and other places, the profile sheets of which he had compared with the profile of the San Juan River. He had seen Aztec Rapids and a few small rapids in Grand Canyon near the foot of Bright Angel Trail and he had those in mind when he reported that the rapids in the San Juan were small. (R. 3774–3775.) In other words, he had made an investigation and comparison before he made the statement "that these rapids were small."

He recalls making the statement on page 2 of the same report: "The voyage was attended by strenuous labor and hardships, such as may always be expected in exploring an unknown canyon with its rapids in an uninhabited region," which statement was made after he had been down the canyon and after he had gained all the knowledge which he now possesses on the subject.

He recalls speaking of groundings when he arrived at Piute Farms, which is a wide, open country, extending from Clay Hill Crossing down to Spencer's camp, a distance of twenty miles. (R. 3776–3777.) The channel of the river there is more or less permanent but the depth of water varies from time to time in the channel, and in that twenty miles the river is of such a character that frequent groundings were necessary, especially during the low stage of

water; as many groundings actually were made in that stretch.

This same condition exists between Moonlight Creek and the mouth of the river. In these stretches if the water would get lower the expedition would stop. (R. 3778.)

The most frequent groundings were encountered in the section between Moonlight Creek and the mouth of Piute Creek but there were a few groundings below.

Between Moonlight Creek and Clay Hill Crossing the San Juan flows through a box canyon with vertical walls and the canyon is not accessible except by boat. The nearest place upstream that a person can get into the canyon is at Slick Horn Gulch.

From Clay Hill Crossing to Mile 53 it is open country; from there is small box canyon extends to about Mile 51.

From Mile 51 to Mile 46 it is open country; from there to Mile 43.5 a shallow box canyon. (R. 3779–3780.)

From Mile 43 there is open country down to Zahn's Camp. There is open country between Zahn's Camp at a place near the mouth of Nokai, and from Zahn's Camp there is a restriction in the high canyon wall extending almost to Spencer's Camp.

From Spencer's Camp it is open country from Mile 37.5 to about 38.5, and from 37.5 to Great Bend there is a narrow canyon, inaccessible except by boats; which extends down to about Mile 27.

From Mile 27 down to Piute Creek at Mile 21.5, is open country on the east side of the river.

He and Loper left the mouth of Piute Creek when they went up to get the supplies cached. After obtaining the supplies they rode about half the way back. They were out of the boat at least half of the time trying to locate deep water and pulling the boat across through the shallow water. (R. 3781–3783.) They had difficulty in finding deep water and they both got out of the boat to search for it, they always had their shoes and leggings off so they could jump out immediately when the boat was grounded. (R. 3783.)

On the trip down the river the first supplies brought to the party overland were brought to Goodrich. (R. 3784.) The next place they received supplies brought in overland was at Honaker Trail; the next, Slick Horn Gulch; the next Piute Farms; then Clay Gulch, Copper Canyon, and Spencers Camp. They obtained some supplies from Indians at Piute Canyon and Loper brought a sack of flour from the mouth of the San Juan up to the thirteen-foot rapid. (R. 3784–3785.)

He has no recollection of anyone except Loper taking a trip down the river to the cache at the mouth of the San Juan, and coming back up. (R. 3786.)

He would judge there were four or five times that it was necessary to stay off the river with the boats because of sand waves and floods, each time lasting from a half day to two days. (R. 3787–3788.)

When he mentioned the grounding that he recalled as having occurred two miles below Clay Hill Gulch,

he merely happened to mention that as one among many others and it was mentioned in preference to others because there the channel of the river is especially quiet and very conducive to groundings. (R. 3789–3790.)

Redirect examination (R., Vol. 21, pp. 3790–3794):

On the trip he and Mr. Loper made upstream to Spencer Camp, they left September 25th, 1921; reached Spencer Camp September 26th, left there September 27th, and returned to the mouth of Piute Creek [the same day].

"Mr. BLACKMAR. In connection with Mr. Miser's testimony, and also in connection with his report of the expedition, I desire to call Your Honor's attention to Complainant's Exhibit No. 95, page 148, which is the Stream Flow Record for the year 1921. That is San Juan River.

"By Mr. BLACKMAR:

"Q. Mr. Miser, this place called 'Piute Farms' has rather an attractive name. Just tell me what the appearance of the country is. What is Piute Farms?

"A. The wide channel of the river there is bordered on the east by open country, which is characterized by a series of gravel-floored terraces, and there are narrow valleys cutting through these terraces. On the west side of the river there is a 'bad-land' country and some high cliffs. Immediately adjacent to the river at the Piute Farms, there was in 1921 a considerable area of willows and one cottonwood. There is evidence that a little tract of land, not exceeding a

fraction of an acre, had once been under cultivation." (R. 3790–3791.) No people were living there and no crops were planted at the time.

When the boats were taken out of the river at the thirteen-foot rapid they were taken out the day they reached there and were not carried downstream and put into the water at the lower end until they started down later. In the meantime, Bert Loper had gone down the river somewhere and brought back the wet sack of flour. (R. 3791–3792.)

When he spoke of the east bank of the stream at Piute Farms he referred to the left bank going down; the river turned southerly in that particular locality.

When he and his party went down the river on this trip they had a map used by Professor Gregory, called "Navajo Reservation," Professional Paper No. 93 of the United States Geological Survey. They also had a map prepared by Mr. Woodruff of the San Juan oil fields and a topographic map of the United States Geological Survey covering a large country and prepared, he believes, in the 80's. All of the maps were so erroneous that they did not know how far they would have to go down the river to reach the Colorado. (R. 3792.) These maps were used little if any.

The "dwellings" noted in the part of his report devoted to archeology are located in the canyon wall a mile or so below Spencer Camp. These ruins were reached from the river and are located in alcoves in the vertical canyon wall but he does not know how they would be reached by the Indians. There were

also some small ruins underneath the huge boulders at the mouth of Piute Creek. There were some crude walls, made of angular boulders near the thirteen foot rapid. All of these ruins are located close to the river, although he found a few in some of the side canyons, a distance from the river. (R. 3793–3794.)

Recalled (R., Vol. 21, pp. 3881–3882):

Identifies map referred to by Mr. Trimble, and it is marked "Compl. Exh. 498."

Recalled (R., Vol. 21, pp. 3901–3903):

Upon being shown Compl. Exh. 500 and 501, he identifies Exh. 500 as being Plate 9, Bulletin 471, of the United States Geological Survey, and is a map of the portion of the San Juan River extending from a point near the mouth of Chinle Creek to a few miles beyond Honaker Trail, and Exhibit No. 501 is a geologic map of the same country and were carried through that country by him.

Compl. Exh. No. 499 is a report of the Geology of the San Juan Oil Field, Utah, by E. G. Woodruff, which report he also had with him at that time.

Compl. Exh. No. 502 consists of two topographic maps pasted together, one the Henry Mountain sheet, the other Abajo sheet, and shows the San Juan River between Bluff City and the Colorado. This map was consulted by him before, during, and after his trip through the canyon in 1921. A portion of the map covering the San Juan River was surveyed in 1884 by P. Holman. Compl. Exh. No. 502 is not an accurate map. (R. 3901–3903.)

CHARLES SPAULDING HOWARD

For Complainant

(Record, vol. 21, pp. 3794–3820, 3882–3883)

He is of Washington, D. C.; a chemist by profession, and associate chemist in the Geological Survey, Department of the Interior. He is a graduate of the Worcester Polytechnic Institute in Massachusetts, in the year 1918. Since that time, with the exception of a portion of a year, he has followed his profession, and for the last few years, since the early part of 1925, has made a study of silt in the waters of the Green, Colorado, and San Juan Rivers.

In May, 1925, he went to the Geological Survey gaging station at Bright Angel Creek in Grand Canyon, to study methods for the determination of the quantities of suspended matter in the Colorado River, using a sampler devised by Mr. Aube, a mechanical engineer in the Water Resources Branch of the United States Geological Survey, and himself. He spent 20 days at Bright Angel Station. From there he went to the Yuma Gaging Station, and from Yuma to Topock, and then back to Bright Angel Station.

In 1928 he was at the San Juan Gaging Station at Goodrich, Utah, going from there to Bright Angel Station, thence to Topock and Yuma.

In June, 1929, he went to the San Juan Station, thence to Lees Ferry, from there to Topock, and thence to Bright Angel Station.

The purpose of the visits during the last two years to these different stations was to get in contact with

the observers at these stations and observe the methods they were using in getting the samples that were to be analyzed. During the last four years he spent about 100 days in field work, observing the methods that are used by the observers. (R. 3794–3797.)

Observers have been stationed at the different gauging stations mentioned at all times during the years enumerated by him [Howard], and in 1925 the observer commenced taking regular silt samples and water samples from the stream. In taking the samples a mechanical sampler is used, and the water can be sampled from any depth of the river at any time, and a normal sample of the water at that depth obtained. Water samples were also taken primarily for the purpose of determining the amount of dissolved mineral in the water. (R. 3797–3797–A.)

These water samples also serve as a check on the minimum quantity of solid matter carried in the water of the river. Samples were started to be collected at the same time at the Bright Angel and Topock Stations. Samples were not taken from the Yuma Station until October, 1927, inasmuch as the Reclamation Service had been taking regular silt samples there. Similar samples have been taken at Lees Ferry since October, 1928. (R. 3797–B.) The samples at Lees Ferry were taken by Mr. Clark, the gauger, and shipped at no particular intervals [to Washington, D. C.], where they are analyzed. Water samples are taken daily and silt samples three times a week, except during the period of rapid fluctuations, especially in the spring.

On the San Juan River, between August 12th and September 21st, 1928, about 570 silt samples were taken; and in the summer of 1929 a special observer was sent to the San Juan River from Washington, in addition to the regular observer, and about 700 silt samples were taken, between the 10th of July and the 21st of September. (R. 3798.)

At Greenriver and Cisco, Utah, samples have been taken daily since August 1st, 1928. (R. 3798.) During the entire period they have taken about 5,000 silt samples and 3,500 water samples. (R. 3799.)

In 1927 Water Supply Paper No. 596–B was prepared by Chief of Quality of Water Division Collins and Mr. Howard, and the paper contains the results of the first year's work on the dissolved material and the amount of suspended matter found in the samples taken. (R. 3799–3800.)

This report, Water Supply Paper 596–B, does not deal with any part of the Colorado River north of Lees Ferry. In July, 1928, the same author and witness published an article in the "Architectural Engineering and Industrial Chemistry" Magazine entitled "Dissolved and Suspended Mineral Matter in the Colorado River," and this article contains the same results as are in Water Supply Paper 596–B, together with the determinations of suspended matter at Bright Angel and Topock. (R. 3800.)

Compl. Exh. No. 492 was received in evidence, special attention being called to Table 3 on page 7. (R., Vol. 21, p. 3800.)

Data obtained for a period of little more than a year would indicate that the quantity of suspended matter in the Colorado River at Lees Ferry is about the same as at Grand Canyon. There are occasions, however, when the Little Colorado increased the load at Grand Canyon a little bit. (R. 3801.)

Water Supply Paper 636–A, "Quality of Water in the Colorado River 1926 to 1928," gives analyses of water from Grand Canyon, Topock, and Yuma Stations on the Colorado River, and from the Goodrich Station on the San Juan River. (R. 3801.)

Compl. Exh. No. 493, Water Supply Paper No. 636–A, received in evidence. (R., Vol. 21, p. 3801.)

Water Supply Paper No. 636–B, "Suspended Matter in Colorado River, 1925 to 1928," contains the results of studies on the silt samples and water samples from all the gauging stations through September 30, 1928.

Compl. Exh. No. 494, Water Supply Paper No. 636–A, received in evidence. (R., Vol. 21, p. 3802.)

This year's reports have not been published. He has the figures, or a summary of the different stations, giving suspended matter carried by the Colorado River and its tributaries during the year ending September 30, 1929. Figures for the silt samples were not available for all of these stations, so he has based these quantities on the quantities he found in the water samples, these quantities are a minimum, rather than the total quantities carried, because of the nature of the samples taken.

At Greenriver, Utah, the Green River carried a total of 50,700,000 tons for that year. (R. 3802.)

He believes that 50,700,000 tons of solid material were carried in the Green River for the year ending September 30, 1929. (R. 3802–3803.) This calculation is based on observations of silt and discharge. The method of calculation of the solid content of the stream is subject to error, and in calculating this discharge he did not make allowance for errors. Where the discharge of silt in the stream is constant, or nearly so, the error is rather small. Under other conditions, or where there is considerable fluctuation, the error may be large, but the methods used in computation are recognized by the Geological Survey to be the proper method of making such calculations. (R. 3803–3805.)

The figures for the same year at Cisco, Utah, show a load of 25,000,000 tons, and the San Juan River at the Goodrich Gauging Station from the period of May 1 to September 1, computed for yearly load, is 60,200,000 tons. (R. 3805). At Lees Ferry, for the same period, the load was 131,000,000 tons. (R. 3805–3806.) It is about the same as the total for the three stations. He believes it may be about 4,000,000 or 5,000,000 tons less; but approximately it is the same load as comes in from the three upper stations. There is no particular reason why it should be the same for that given period. The load, as it passes Greenriver, does not go instantaneously past the junction of the Green and the Colorado Rivers, or past the Lees Ferry Station. Now, it might be

that we could pick a certain period so that we would get the load of these three upper stations going past the Lees Ferry Station. (R. 3806.)

He means that the same 50,000,000 tons may not have reached Lees Ferry; there may have been a load that reached Lees Ferry; of that load of 131,000,000 tons that reached Lees Ferry, 50,000,000 tons may have come from Greenriver, but it may not have come during that particular year. He has shown that between their stations at Bright Angel and Topock, the load for any given period is quite different; during the fall, the Topock Station carries a larger load than Bright Angel Station; the Bright Angel Station is about 250 miles above Topock. But during the spring floods, the larger load is carried at the Bright Angel Station.

There must be a deposition between those two stations, or material is carried in some manner that we do not measure. The meaning of these figures all depends on other factors; that is, it depends on volume of water and velocity of water. That is, 50,000,000 tons at Greenriver, with a certain amount of water, would have a different effect than 50,000,000 tons with other amounts of water, because this 50,000,000 tons is based upon the quantity flowing by Greenriver; they have to consider that.

The SPECIAL MASTER:

"Q. Yes; but what I mean is, that a showing of 50,000,000 tons, we will say, in the Mississippi River at a given point would be quite different from a show-

ing of 50,000,000 tons in the Connecticut River at a given point?

"A. Yes, sir. I think I can answer that in this way: We figure the percentage by weight carried at these various points. At Greenriver, it is 0.66, and at Cisco 0.27. Now, the river flow at Greenriver and Cisco are the same. So the water at Cisco is much clearer than the water at Greenriver. On the San Juan, the percentage was 1.91 for this period. The San Juan carries less water than either Cisco or Greenriver; so it is much muddier. The Colorado River at Lees Ferry had a percentage of 0.64, nearly the same as the percentage at Greenriver; but the flow at Lees Ferry is a little over three times the flow at Greenriver; so it is clearer at Lees Ferry." (R. 3806–3808.)

At the Bright Angel Station in the Grand Canyon, the load was 152,000,000 tons for the year (ending September 30, 1929). The quantities given take into consideration only solid matter which is carried in suspension, and has nothing to do with salts carried in solution. (R. 3808–3809.) There is a relationship between the velocity of the stream and the quantity of silt carried, but he was unable to state just what the relationship is. When the velocity of the stream becomes sufficiently slow, the suspended matter is deposited, but he is not able to state when such deposition would take place, because he is not familiar with the physical conditions of the stream. (R. 3809–3810.)

The term "bed load" was introduced by Gilbert in his work, the "Transportation of Débris by Moving Water," and refers to certain amount of material transported along the bed of the river; it is in this way that he used the term as applied to the Colorado River and its tributaries. Part of this material is in suspension and part is rolled along. That part being rolled is termed "saltation" by Gilbert. (R. 3810.)

The terms "scour" and "fill" are applied to changes in the level of the river bed. These changes are determined while making soundings and taking samples. If a greater depth is given for the gauge height, they say the bottom is scoured out; if the depth is less than the gauge height, they say a fill has taken place; and a place that is scoured out may be filled up at another time, making a kind of continuous process (of scour and fill). (R. 3811–3812.)

Cross-examination (R., Vol. 21, pp. 3812–3820):

Earlier records, with reference to matter in solution (and suspension) in these rivers, appear in Water Supply Paper No. 274, and cover samples taken at Yuma about 1890; and samples taken in 1904 by the Bureau of Reclamation on several streams of the Colorado River Basin. (R. 3812.)

Samples from the Little Colorado have been tested infrequently when a man happened to be passing a station, there being no regular observer. He doesn't know under what conditions the samples were taken, nor has he ever seen the Little Colorado, except

where the Santa Fe Railroad passes at Flagstaff; and he has no information concerning the content of the water, except such as was gleaned from the few samples taken. The samples he has taken can be found in evidence introduced. (R. 3813.)

When he says that there are 131,000,000 tons in the year at Lees Ferry, and 50,700,000 tons at Greenriver, and that there is three times as much water at Lees Ferry as at Greenriver, then the amount of suspension would be proportionately about the same as far as the clarity of the water is concerned. He means that at Greenriver, if they have this 50,000,000 tons, and the flow of the river was increased three times, it might very easily carry 150,000,000 tons, he believes. This figure means that with 150,000,000 tons at Lees Ferry, there was three times as much solid material carried at Lees Ferry as at Greenriver. There was about three times as much water. (R. 3815–3816.)

The amount of suspended matter carried in the San Juan, 60,000,000 tons per year, is based on a mathematical average of 1.6 per cent of solid matter carried in each ton of water through the year.

The figures of 60,200,000 tons at the Goodrich Station were taken from samples obtained from May 1 to August 30 or the quantity May to September, and took the mean discharge for the year, to compute the year's load.

He is not familiar with the river except for the purpose of getting silt. The figures for the silt contained in the San Juan were based on a math-

ematical average of 1.6, and the figure was a little lower than that obtained by the Bureau of Reclamation in 1915 and 1916. So he thought he was using a conservative figure. He believed his figures were not too high, and he would therefore get a conservative estimate of the total amount carried by the river water and suspended matter together; in every ton of river water there is 1.6 per cent of suspended matter. (R. 3817–3820.)

SAMUEL KENNETH LOVE

For Complainant

(Record, vol. 21, pp. 3820–3864)

He resides at Washington, D. C., and is by profession a chemist; was educated in the University of Florida, having graduated from that institution with a degree of Bachelor of Science in 1927, after which he took something over a year in graduate work along chemical lines and joined the United States Geological Survey in June, 1928, which at the present time is his professional employment.

He has had something to do with the determination of amount of silt in water samples from the San Juan, Colorado and Green Rivers, in the laboratory and has done field work on the San Juan River, having been stationed at the gaging station at Goodrich on the San Juan from July 10th to September 21st, 1929, for the purpose of observing the amount of silt carried in the river there. (R. 3820–3821.)

A typical day's work would consist of taking samples across the river three times a day, one sample

being taken about seven or eight o'clock in the morning, the next just after noon, and the next in the afternoon. During the low stages of water the samples were taken at the bridge at Goodrich, and during high stages from the cable from which discharge measurements were made, and he usually took from ten to thirteen samples a day.

The samples were taken in pint milk bottles, similar to the method described by Mr. Howard, filtered, dried, and weighed. Having already the weight of the filter paper, the weight of the silt is obtained by deduction, and knowing the weight of the bottle and its contents, the percentage of silt in a pint of water is a matter of simple calculation. (R. 3822.)

The samples were taken in such a way that the milk bottle was not quite full when it reached the surface of the water, thus preventing any loss of sediment if there happened to be an excess in the river at the time.

He observed several periods of high or flood water, one specific instance occurring July 30th, 1929, at which time the gage showed a rise of four feet in twenty-five minutes. This rise was caused by a flood down Gypsum Creek. During that period the suspended matter increased from 5.5 to 8.4 per cent; the water became very red, but the color disappeared two hours after the peak stage was reached. (R. 3822-3823.)

On August 1st, 1929, the gage showed a rise of 1.2 feet in two hours, and the quantity of suspended matter increased from 8 per cent to 15 per cent.

On August 12th, 1929, the gage showed a rise of 18.2 feet in twenty hours, the maximum rise being 10.3 feet in five hours and the suspended matter increased from 4.4 per cent to 8.9 per cent.

September 20th and 21st, 1929, the gage showed a rise of 6.8 feet in two and one-half hours, and the quantity of suspended matter increased from .44 per cent on the morning of the 20th to 40.8 per cent on the morning of the 21st.

The percentages referred to are percentages by weight (R. 3824), so that in the example given where the percentage increased to 40.8 per cent in one hundred pounds of the solution there would be approximately 40 per cent of sand and sediment and 60 per cent of water.

He has no other figures as to floods, but he has calculations of the total load for that period or for any of the periods. (R. 3823–3826.)

On a period of rather high water, from July 27 to August 5, 1929, the total load carried by the river was 28,800,000 tons; average percentage of 8.9. On August 12, the period of highest water, he had a total load calculation of 8,800,000 tons for the 24 hours. On September 21, a period of less water, but at the same period of 40 per cent of silt, he had a total load of 20,000,000 tons. That is based on the

calculation of two sets of samples for that day. (R. 3826–3827.)

During his work he made some observations as to the process referred to as "scour and fill" and has charts which show graphically some of the changes, the charts being based on soundings made from the cable during the period he was there.

This chart, Compl. Exh. 495, is made up based on soundings taken at nine different points on a cross-section of the river at the cable, this being the thirty-foot point, and this being the 190-foot point. These surfaces represent the surface of the river referred to the gage height at that particular period. And he plotted these points, referred to given gage heights. For instance, on September 10, he had a point, say, four feet above zero on the gage. But back on August 15, that same point was only two feet above the zero of the gage between those two times, August 15 and September 10, a fill of two feet at that point. Other points were similar.

That indicates very nearly the width of the river at that [particular] point. This 30-foot point was usually about five or six feet from the edge of the right bank of the river, and this 190-foot point was about 10 to 15 feet from the edge of the river. (R. 3827–3828.)

The width of the river at that point would, therefore, be about one-hundred and sixty-five or one hundred and seventy feet. There is a narrow point, however, considerably above the cable.

The chart (Compl. Exh. 496) tends to show that there was a fill of 1 to 2 feet between the date of the lowest line and the date when he completed the highest line. (R. 3828-3829.) This exhibit shows greater variances in the amount of scour and fill, but they were based on three points of soundings across the river, whereas this other one was based on nine points of soundings. Here, on August 13, it was 0.2 of a foot on the gage above zero. On July 29 it was at 6.4 above zero, showing that between the 29th of July and the 13th of August there was a scour of a little over 6 feet at that particular point. It had washed out that channel, or the bottom, rather.

"Q. What does the zero of the gage denote? (R. 3829.)

"A. It has no significance, except as a standard for reading the level of the water. In other words, it does not mean on the gage, where it reaches zero, that that is the bottom of the bed, but it means a reference point—something that is standard."

He took the depth of the water to make up the charts.

This particular zero mark has no bearing on question of where the bed was; it shows the amount of scour between those two intervals.

He made the soundings there. For instance, if he had a gage height of 14.4 feet and the sounding at that particular time at that particular point was 14.2, the difference between 14.4 and 14.2 is .2 (or $\frac{2}{10}$) of a foot, which gives him something of a basis for locating his points. For instance, take that day in there,

July 30, 1929; the depth of the water on that day was 8.6; that is, 8.6 feet. It is spoken of in tenths of a foot. (R. 3830.) That is the depth of the water at that point.

On August 13 the depth of the water was 14.2 feet; the difference between this and 14.4 is .2. (R. 3931.)

The readings which appear on the chart were taken at the same time he took his samples. Readings for maximums and others that gave representative figures were taken at different periods.

In taking the measurements he used a one hundred pound weight attached to the end of the cable, and they were taken from the cable car which crosses the river at Goodrich.

Compl. Exh. No. 497 is a chart which shows the percentage [ratio] of silt and suspended matter carried by the river to the discharge or total flow of the river. The dotted line indicates the amount of suspended matter in per cent and the solid black line indicates the discharge in second-feet. (R. 3831-3832.)

"Q. Now, just take some figure on there, and illustrate what you mean.

"A. On August 1st the percentage of silt was about 14 or 15 per cent, and the discharge for the same period was about 23,000 or 24,000 second-feet. However, the peak discharge was not recorded until the second day of August, which was about 27,000 or 28,000 second-feet, at the same time, the per-

centage of silt had dropped off to about 10 or 11 per cent." (R. 3833–3839.)

There is no definite relation between the discharge and the amount of sediment carried in the river, but there is in general an increase in the amount of suspended matter. That is, during an increase of the discharge there would be an increase in the percentage of suspended matter carried. (R. 3833–3840.)

Cross-examination (R., Vol. 21, pp. 3840–3859):

He can not give the amount of matter in solution for the fifteen-day period covered by Exhibit No. 497, nor can he give the amount of suspended matter for that period, but the amount of suspended matter carried by the San Juan for the total period July 10th to October 1st, 1929, was 150,000,000 tons. (R. 3840.)

The period to October 1st includes ten days during which the samples were taken by an engineer of the United States Geological Survey other than himself, and the figures given are a guide in determining the amount of solid matter carried by the San Juan River at that particular place for that particular time.

The place [Goodrich] where the samples were taken was selected merely as a desirable point for the determining facts with reference to the river. (R. 3841.) He has no reasons for believing that there is anything peculiar about that particular point.

The period over which tests were taken was eleven or twelve weeks. If the river had carried 150,000,000 tons in thirteen weeks, the annual discharge would be something over 600,000,000 tons, this being an example based on assumption.

There had been rather careful tests made on the Colorado River at Lees Ferry [for the amount of suspended matter in the water of the river]. (R. 3843.)

On his trip to Goodrich he reached the San Juan River first at Bluff but did not stop there. He went to Goodrich from the Washington office, and when he left Goodrich he went directly back to Washington, and he was not aware of the pendency of this suit, nor did he know anything about the matters in the issue nor about the question of solid matter carried in suspension by the San Juan River as a matter in issue in this case. He first learned that it would have a bearing on litigation in progress in roundabout ways during his stay there [Goodrich].

He has no figures to show whether or not there is more solid matter carried near the bottom of the river than in any other portion, and in taking his samples he guarded against any possible error in this respect by lowering the sample to the bottom and immediately pulling it toward the surface, thus getting water from all sections and representing as nearly as possible the amount of silt carried between the surface and the bottom. He had information or an understanding that the water carried more silt near the bottom but had no figures to show that fact.

The understanding was such to make him use care in taking his samples, so that it would be a true representation of the section at which it was taken. (R. 3845–3847.)

As stated before, the amount of solid matter carried in suspension increased as the discharge of the river increased. As the river rose, the silt did go up, but he stated back there that the peak of discharge was not reached until the next day, on a falling stage of silt.

At the time of the peak of discharge the percentage of silt content was something like 12 per cent or 11 per cent. (R. 3848–3849.)

The forty per cent solid content carried on September 21st was not shown on the chart, because it was included in a period of only two or three days; and the chart was based on a ten or fifteen day period, which was thought to be more representative than to show just one large flood. (R. 3849.)

He had no way of determining whether or not silt and mud from the bottom of the river were stirred up when he lowered his sampling device to take samples of water from the river, and he does not recall whether he had information on the subject at that time.

It is not his opinion, from his experience, that in lowering the one hundred pound weight to the bottom of the river and raising it that silt is stirred up and the samples made muddier than they otherwise would be, because the river is so turbulent that it would do so much more to cause such a condition than would the mere dropping and lowering of the weight. (R.

3850–3853.) It is not his opinion that the river is so muddy that it is just as heavily laden with solid matter at the surface as near the bottom. (R. 3854.)

As he before stated, the samples were taken so as to represent a true vertical cross section of the river at the point where it was taken and in such a manner as to prevent any extra amount of sediment entering the bottle from any particular point in the cross section of the stream. (R. 3855–3857.)

In taking his samples he had in mind obtaining an accurate sample of water from the entire stream along a given line from top to bottom instead of water from the top or bottom alone, and he understood that the stream was more heavily laden with solid matter in the bottom than at the top. He did not have in mind the fact that the hundred pound weight might stir up sediment in the bottom of the stream, because he thinks it would not make any difference materially in the amount of sediment obtained in the sample, and he took no particular care to avoid stirring up the sediment that might have been at the bottom because he doesn't think that it would make any difference. (R. 3857–3859.)

Redirect examination (R., Vol. 21, pp. 3859–3861):

The weight used was a standard torpedo-shaped weight used by engineers, approximately five to seven inches in diameter and about eighteen inches long and was suspended by a windlass and connected with a wire. The weight was let down until he got the

depth, pulled up and the depth recorded, and the bottle was put in the sampler and lowered so that the bottle would not reach quite as far as the weight because it was on the weight.

The weight rested in a horizontal position on the bottom and the sampler was on the weight or just above the weight and the bottle was resting on that so that the bottle was in most cases 1.2 feet above the bottom of the weight.

The plate opposite page 20 in Complainant's Exhibit No. 494 shows a plan of the sampler used and another weight is let down. It is so arranged that the bottom weight is 1.2 feet from the top of the bottle. (R. 3859–3861.)

"Q. Now, the method which you used out there in taking your samples—is that the approved method used by the Department?

"A. It was not identical with the method that has been used, because I did not use the cap in the bottle with a hole that had a paper pasted over it; I found that I could not let this weight down in such a way as to puncture that hole, because at a period of high water the amount of submerged paper that was carried was so great that it would lodge on this carrier [indicating], and this [indicating] could not get down far enough to strike that plunger and arm [indicating on plate]; so that instead of doing that, I left that hole in the cap open, and lowered it to the bottom, and pulled it directly to the surface again, in such a

way that it would not be filled when it reached the top." (R. 3861.)

Recross-examination (R., Vol. 21, pp. 3862-3864):

He did not remove the weight at all in taking his samples and he could tell when the weight was at the lowest point from the effect on the windlass arm. (R. 3862.)

When he lowered the weight he retarded its progress by a brake on the windlass as it went down toward the bottom and allowed it to proceed down until it would go no farther of its own weight. He does not think that it would penetrate several inches of mud at the bottom.

He does not think it would be possible to get the milk bottle down without its being attached to the weight, except possibly in very low stages of water. (R. 3862-3864.)

KELLY W. TRIMBLE

For Complainant

(Record, vol. 21, pp. 3865-3881)

He is 44 years of age, a topographic engineer by profession; and is employed at the present time by the Government in the Interior Department. His education and training consisted of four years at the Washington and Lee University, and twenty-three years with the United States Geological Survey, with the exception of two years when he was with the engineering corps of the Army as an officer.

In 1921 he was connected with a survey on the San Juan River, the purpose of which was making a plan and profile of a portion of the San Juan and Colorado Rivers. The party organized at Greenriver, Utah, part of the personnel coming from Moab and Bluff and one from Blanding. They started down the San Juan River with the boats from a point near Bluff on July 18th, 1921. Mr. Miser was a member of that party as geologist, and Mr. Blake and Mr. Loper were boatmen. (R. 3865–3866.)

The ultimate purpose of the survey was to investigate the feasibility of reservoirs and dam sites on the San Juan and Colorado Rivers, together with power possibilities, his particular assignment being to make plan and profile surveys up to the limiting or 3,900-foot contour, which does not extend up the river as far as Chinle Creek. He was chief of the party and it was one of his duties to arrange for the purchase of supplies. Some supplies were purchased at Salt Lake City and moved by truck to Goodrich, a portion of them was taken on the boats before arriving at Goodrich and it was arranged to have the balance delivered by a packer at different points accessible to the river as far down as the condition of the trails would permit. Arrangements were made with the packer to meet them at particular points, such as Slick Horn Gulch and Clay Hill Crossing, it being contemplated in advance that they would reach these points on certain days, and at each point they were met arrange-

ments would be made for a meeting at a further point. These supplies were brought overland with the exception of those they had to take in the boats, which would not last longer than ten or fifteen days, as the boats did not carry more than that amount, together with the equipment and members of the party, so that supplies were loaded on at one point sufficient to carry them to the next point of meeting on the river.

The survey was carried on with the latest improved instruments and the plan sheets were made in the field in pencil and later inked in at the office by him. The profile sheets, of course, were compiled and platted in the office. Sheets 14, 15, and 16 of Complainant's Exhibit No. 10 are reproductions of the maps which he prepared in the field. (R. 3867–3870.) He has examined them and knows them to be a correct reproduction of his field work.

In making the survey he indicated on the maps the various rapids to which he came on the San Juan River, they being shown by frequent dashes within the solid blue line representing the water line of the river. The white spot in the river at Mile 21, Sheet 14, is an island. In addition to rapids and islands there are shown between the shore lines of the river on the map, sand bars, and large boulders that occur in rapids, and the rapids shown were actually observed by him and measured as to fall. (R. 3870–3871.)

He has personally been over the ground at Piute Farm and as he recalls, the left bank or left side of the stream is more open than the right, where hills

rise precipitously from the stream. The land immediately adjacent to the river was sandy but a short distance back became rocky and in some cases solid rock but with more or less a gentle slope of possibly fifteen per cent; it was dissected by a number of shallow hollows, some being thirty or forty feet deep. There were no cultivated lands and no people there at all. (R. 3870–3872.)

[It is stipulated that his testimony as to what happened on this trip down the river in reference to operation of boats, etc., would be the same as that of Mr. Loper and Mr. Blake.] (R. 3872.)

He also made a trip on the Green River between Green River, Wyoming, and Greenriver, Utah. (R. 3872.)

The map sheet 46 of Compl. Exh. No. 10 was prepared by him from surveys and other maps made by the Reclamation Service. He has checked the map as to elevation in order to tie his work into it. The same is true as to sheets 44 and 45, sheet 44 being prepared in the same manner as were the maps on the San Juan, and the data shown on the map was observed by him at the time the map was made. Sheet 43 is the same as No. 46 for the Reclamation Service. (R. 3873.) Sheet 42 represents his surveys, inking, and compilation. Sheet 41 was partly prepared by him and partly by Mr. Cornelius Schnurr of the Geological Survey in 1914. Sheet 40 was prepared by Schnurr and elevations checked by him [Trimble].

Sheet 39 was partly prepared by him and partly by the Reclamation Service. Sheet 38 was prepared by him. Sheet 37 was prepared partly by himself and partly by the Reclamation Service. (R. 3873-3874.)

That brings it down to Greenriver, Utah. (R. 3874.)

The sheets just referred to which were prepared by Schnurr and the Reclamation Service are on file in the Department of the Interior.

After reaching the Colorado River in 1921 he did some work there between the mouth of the San Juan for a distance of twenty-five or twenty-six miles down the river. He prepared all of his own work, extending from about Mile 78 on the Colorado River to about Mile 51 on the river. This work is indicated on sheets 4, 5, and 6 of Compl. Exh. No. 10.

The profile sheet in the back of Compl. Exh. 107, showing the particular sections of the river on which he worked, were prepared by him from data obtained while he was in the field. (R. 3875-3876.)

In surveying a rapid, elevations were taken both at the head and at the foot of the rapid, which would give the fall of the rapid. (R. 3876.)

Cross-examination. (R. Vol. 21, pp. 3876-3883.)

As he remembers, Mr. Schenck did not have charge of the delivery of supplies to his party. He came in with Mr. Gerdine on a visit to the party probably, but had apparently nothing to do with the delivery of supplies.

He had purchased quite a quantity of supplies in Salt Lake City, and had them shipped to Goodridge

[sic Goodrich] where they were cached, and during most of the packer trips [Wesley Oliver] had taken supplies from the cache, supplementing them from other places and supplies were never furnished him except when he asked for them. (R. 3876-3877.)

He saw Mr. Schenck on the San Juan but could not say what his duties were.

While he was working on the Colorado from the mouth of the San Juan down, some supplies were left for him at the mouth of the San Juan by his direction to Mr. Clemmeth. He understands these supplies came down the river and were probably loaded on boats somewhere near Hite. The next supplies were brought to him at a point five to seven miles below the mouth of Aztec Creek from Lees Ferry, Arizona. He does not recall receiving supplies at any other time. (R. 3878.) The supplies were delivered at the points below Aztec Creek by a man named Mayo, as he recalls, who brought them up in a power boat owned by the Edison Company, and Bert Lopez was on the same boat.

Mr. Wimmer passed along the river, and spent one night at his camp somewhere between Aztec Creek and West Canyon Creek. He is quite sure that Wimmer did not leave him any supplies. (R. 3879.)

Before going on the river he recalls distinctly studying one map of the San Juan River and he thinks he had one map with him, probably that accompanying Gregory's report of the Navajo Reservation. (R. 3878-3880.)

Redirect examination (R., Vol. 21, pp. 3880-3881):

He used a map, or a duplicate of a map handed him by counsel, and studied it prior to going in the camp. If he had had a map such as prepared by him in Complainant's Exhibit No. 10 it would have materially assisted in navigating down the river.

After completing his work on the Colorado he went down the river from Mile 52 to Lees Ferry in two sixteen foot, three and one-half foot beam, eight inch rake, open row boats and from there by truck to Flagstaff [Arizona].

On the San Juan he also had one decked over boat known as a Cobb, or a Galloway & Stone type row boat. (R. 3880-3881.)

WILL R. CRENOWETH

For Complainant

(Record, vol. 21, pp. 3884-3902, 3903-3920, 3926-3937)

He resides at Washington, D. C.; is a topographic engineer by profession, and is employed by the Government, in the Department of the Interior, as an associate topographic engineer. He first became connected with the Government service in 1907, and has been there ever since, with the exception of about a year and a half.

He has been on the Green River from Greenriver, Utah, down to its mouth, and on the Colorado from the mouth of the Green River down to Lees Ferry, having made the trip on the Green River in September, 1921, in company with Mr. Page, geologist, Mr.

LaRue, hydraulic engineer, John Clarkson, cook, and Stout, Lee Lint, and Tasker, rodmen. His object on the trip was to make a plan and profile survey of the Colorado River from the mouth of the Green down to the mouth of the San Juan, for the purpose of investigating dam sites mainly for power purposes. (R. 3884–3885.)

The party left Greenriver, Utah, with four boats, about eighteen feet long, three and one-half feet wide, that drew eighteen inches of water. They were row boats. One of them was equipped so that an outboard motor might be attached and they had an outboard with them for the trip.

The purpose of this trip was to complete the mapping from the mouth of the Green River to the mouth of the San Juan. He did no survey work between Greenriver, Utah, and the mouth of the Green River, so that the boat trip was continuous down. The party left Greenriver, Utah, September 12th, 1921, and reached the mouth of the Green River September 15th, according to his memory, which he refreshed with a diary of Mr. LaRue's. (R. 3886–3888.)

He remembers that the river from Greenriver, Utah, to the mouth of the San Rafael was swift and full of rapids, but does not recall any difficulties getting the boat through. He recalls, generally, Labyrinth Canyon, but does not recall any difficulties in getting the boats through either Labyrinth or Stillwater Canyons, nor does he recall any sand bars. After reaching the mouth of the Green River the party continued on down through the Cataracts,

the survey commencing at the mouth of the Green River. (R. 3888–3889.)

The survey was made up to the 3,900-foot contour, similar to the one being made by Mr. Trimble. When the survey began he does not know what the stage of the water was because he had nothing to compare it with.

Mr. Blackmar. In connection with the witness's testimony, I desire to call the Court's attention to Sheet 51 of Compl. Exh. 94.

Mr. Farnsworth. This [indicating sheet] is the Green River.

The Special Master. What was the Green River September 12 to 15?

Mr. Blackmar (examining sheet). September 12, 3,890; September 13, 3,780; September 14, 3,640; September 15, 3,480.

I call attention to Sheet 65 of Complainant's Exhibit 90, which gives the stream flow at Lees Ferry in September of that year. (R. 3889.)

He prepared Sheet 13 of Compl. Exh. No. 10 from data actually obtained by him at the time the survey was made and he has indicated on that map the rapids.

He also prepared Sheet 12 of Compl. Exh. No. 10, but the figures and arrows appearing on the map in red lead pencil were not put there by him but were put on by Mr. Hoyt.

Sheets 7, 8, 9, 10, and 11, Exhibit No. 10, were also prepared by him. (R. 3889–3890.)

The islands shown on the map between Mile 129 and Mile 130, Mile 125 and Mile 126 on Sheet 8, and all other things perceptible to the eye were shown on the map. He does not recall, however, showing any rocks.

His trip from Hite was started between the middle of July and the first of August, the party first reaching the Colorado River at the mouth of the Fremont River, having come [overland] from Greenriver, Utah, with supplies. (R. 3891.) The boat arrived a few days later, having been brought overland from Greenriver and down North Wash to the Colorado River. The party had assembled at Greenriver, Utah, but did not start down the river on this trip due to the flood stage of the river.

On his trip from Greenriver, Utah, down to the Cataracts he does not recall meeting any other boats on the rivers nor did he see any settlers below the mouth of the San Rafael. There was one settler at Hite, a man by the name of Tom Humphrey. (R. 3892-3893.) In the fall of the year he saw one large, cumbersome boat, a rowboat, that belonged to an old man, probably a prospector, who stayed with them one night, but whose name he does not recall.

There is a trail along portions of the river on both sides, from Freemont River down to Halls Crossing, but he does not recall just where they lead to. (R. 3893-3894.)

On this trip he went as far down as the mouth of the San Juan River with his work, and after finish-

ing there went on down the Colorado and met Mr. Trimble's party, it being expected that he would help with Mr. Trimble and Mr. Fowler. After seeing Mr. Trimble he went down to Mr. Fowler's party and then down to Navajo Creek, where he commenced work.

On his first trip down to the Colorado River he went from Hite down to Halls Crossing, from where he returned to re-outfit for the Cataract trip, being met by team and wagon and travelling about fifty miles overland to a ranch west of Kanesville in Temple, Wash. There they were met by a truck in which they went back to Greenriver, Utah, by way of Sevier Valley. The boat was left on the river.

On his first trip below the Cataracts there was quite a rapid below the mouth of North Wash, which was not there when the second trip was made. (R. 3894–3895.) The date of the second trip was October 2nd [1921]. To the best of his recollection, the fall of the rapid on his first trip was about five feet, while on the second trip there was no perceptible fall.

He also prepared profiles which accompanied the topographic sheets testified of., (R. 3896.)

Cross-examination (R., Vol. 21, pp. 3896–3899):

He was at the mouth of the San Juan when he met the old man with the clumsy rowboat. He was coming downstream and had come, he said, from Grand Junction, Colorado, and planned to go on through Grand Canyon; at any rate, he went on down the river from his, Chenoweth's, camp.

All of the rapids indicated on the sheets called to his attention in Complainant's Exhibit No. 10 were mapped by him but the matter appearing in red lead pencil on the maps and the black ink lines on Sheets 7 and 13 were added by some one else, also the coloring in green and red along the river on these sheets was added, as was also the descriptive matter in green and red lead pencil.

A little portion of Navajo Creek on Sheet 4 was prepared by him.

Sheets 5 and 6 were not prepared by him; Sheet 7 was.

They received supplies on the lower river from Greenriver (Utah) first at North Wash and then at Hall's Crossing. At these points the provisions were packed up; nothing was carried on the river. To his knowledge, supplies were never delivered to them on the lower river by boat. (R. 3896–3899.)

Redirect-examination (R., Vol. 21, 3899–3901):

The supplies spoken of came in overland from Greenriver. Emory Kolb and Lee Lint were with the party. He (Chenoweth) preceded the boats through the Dark Canyon Rapids, he being that far ahead with his work. The operation of the boats was left to Mr. Kolb and Mr. Lint.

He has partly checked Complainant's Exhibit No. 80, entitled "Rapids, Rapid Water, and Quiet Water," compiled by W. G. Hoyt.

What he means by "partly checked" is that he has looked it over, but did not check it mile by mile with the profile. (R. 3899 3901.)

Recalled (R., Vol. 21, pp. 3903–3920):

He has checked Sheets 7 to 13, inclusive, Mr. Hoyt's Exhibit 80 with a profile made from his notes and finds that the places where Mr. Hoyt has indicated rapids correspond with the rapids which he saw while making his survey. (R. 3903–3905.)

Cross-examination (R., Vol. 21, pp. 3905–3920):

The profile sheets referred to by him show the steepness where the rapids occur; show the fall of the river along the sections indicated on each sheet.

He was upon the ground and observed the rapids. He noted as rapids on Sheets 7 to 13, both inclusive, of Compl. Exh. 10—all rapids that were visible upon the river from an actual examination of it.

Now, have you made any check between Mr. Hoyt's exhibit sheets 7 and 8 of Compl. Exh. 80, and your maps which were made from actual observation on the ground, and upon which you say you indicated every rapid that was visible?

In the Glen Canyon the rapids are not indicated with a symbol on that map.

There are two or three rapids that are called rapids in the Grand Canyon that are not indicated on that map.

It has occurred to him that the rapids were not indicated with a symbol on that portion of Glen Canyon. They were not indicated because they are smaller rapids than he had been encountering. He put down on that map everything that he called a rapid, except that in the inking the symbol has not

been put on two or three of those rapids in the Glen Canyon. (R. 3919.)

The SPECIAL MASTER. Are you ready to proceed?

Let the record show that last evening after recess at my request Mr. Burdick looked over the sheets in Complainant's Exhibit 10, showing rapids in Glen Canyon, and that he made a comparison between the sheets as they originally were drawn and as added to by Mr. Hoyt, and that he found only one stretch designated as a rapid by Mr. Hoyt that was not designated as a rapid by Mr. Chenoweth on the original sheets.

Mr. FARNSWORTH. All right.

Mr. BLACKMAR. That is, the comparison was made with Mr. Hoyt's Exhibit No. 80?

Mr. FARNSWORTH. Yes; with Mr. Hoyt's Exhibit No. 80.

Mr. BLACKMAR. That one rapid, as I recall it, was Trachyte Rapid.

Mr. FARNSWORTH. Yes.

Mr. BLACKMAR. Mr. Hoyt shows a rapid there and Mr. Chenoweth does not. (R. 3936–3937.)

ALVAH T. FOWLER

For Complainant

(Record, vol. 22, pp. 3957–3982, 4066–4069)

He is of Washington, D. C., and is a topographic engineer by profession, in the employ of The Geological Survey, in which profession he has been since 1901. He is a graduate from Dartmouth College and the Thayer School of Engineering. (R. 3957.)

He has had some experience on the Colorado River, having been connected with a survey for the Yuma project in 1921, at which time he covered Glen Canyon from Lees Ferry up to about mile 51.

The purpose of the survey was to make a plan and profile survey of the river and map the area which would be flooded by the proposed dam, located about five miles above Lees Ferry. There were about nine men in the party, he being chief. (R. 3958.) The work was done with one and later two flat-bottom skiffs, about sixteen feet long, together with a larger boat, intended for hauling supplies. This larger boat was flat-bottom—like a scow—blunt bow and stern, about twenty-four feet long, four or five feet wide, and three feet high. The scow was operated by Mr. Marrs. The scow was not at Lees Ferry when he arrived there the early part of July and did not get there until the early part of August. At which time he had started his work up the river and was using the row boat equipped with an Evinrude motor, and operated by Jerry Johnson. (R. 3959–3960.) The camp was not moved from Lees Ferry until after the larger boat came in, at which time they moved up the river about eleven miles. After completing the work there they moved to a point about seventeen miles above Lees Ferry. The moving was accomplished by use of the small boat, it being necessary, however, to tow it up, because the motor was broken down or working badly. (R. 3960–3961.) From mile 17 they went back to Lees Ferry, rowing the small boat, and taking the

party back with all equipment. After arriving at Lees Ferry they went back on the Mesa and made a survey of the lands that would be flooded by the water backed up by the dam. This work was carried up as far as Warm Creek, a distance of about twenty miles above Lees Ferry, the work at that time being on the right hand or west bank of the river. (R. 3961.) After completing the work to Warm Creek on the Mesa he went down Warm Creek, where one of the small boats was left for his use, and resumed work along the river. In working between Warm Creek and his last camp he floated back down the river and stayed there a short time to complete the work. The camp was not maintained at that point, it was moved to Warm Creek with a small boat, the motor at that time having been repaired. (R. 3962.) On the trip up to Warm Creek the motor broke down, the boat was towed a ways, the motor was repaired and they proceeded to Warm Creek with the motor.

Supplies were taken to Warm Creek when they went down by pack train, and he thinks supplies were brought up from Lees Ferry by Mr. Marrs. From Warm Creek they continued on up to mile 51, and from that time on received all supplies from Lees Ferry, they being brought up by pack train and by the large boat. (R. 3963–3964.) He would estimate that two-thirds of the supplies were brought up by pack train. Mile 51 is about ten miles below the Crossing of the Fathers which he thinks is about mile 41. There is a trail along the north bank of the river from Lees Ferry up the river to mile 51, the

lower part being back quite a ways from the river, the upper part on the bench just above the river. (R. 3964.)

He found the pack train more dependable in bringing supplies up the river. He was on the big boat on its trial trip in August and when camp was moved the first time. He observed the big boat on the river when he was on it and on one occasion, when it was trying to bring supplies to his last camp he saw the boat on the river below and could see men wading around trying to find a channel in order to get up the river. (R. 3965.) The boat did not reach it. (R. 3965.) The supplies were dropped back to the old camp about mile 41, from which point they were taken up to the last camp by pack train. It was necessary to tow the boat upstream on his first move. (R. 3966.)

While he was working on the river he saw only one boat, owned by a prospector, who came down the river opposite his camp, but whose name he does not know. He was at work, and does not recall that he helped in the operation of the big boat.

He noticed changes in the channel of the river at the camp at Lees Ferry, and more particularly, at camps above Warm Creek the changes were taking place rapidly. (R. 3966–3967.)

The changes in channel at camp above Warm Creek was principally a filling up with sand, bars being deposited on the inside of the curves, and occasionally it would shift and cut through a deposit

that had already formed before—well, a slight rise due to any shower above would cause a change in the course of the river, it would occur within 24 to 48 hours. In going upstream from Lees Ferry, we also noticed in operating—we worked up as far as about nine miles from the Ferry, and there were occasions there where—there were showers upstream heavy showers, and the level of the river would change, and we would find different conditions in the channel the next day, when we went up the river had raised a little and the channel would be somewhat different, and it would be still different when we came back that night. (R. 3967-3968.)

He could see changes in the channel, principally by the river cutting at the edges or through a sand bar that had previously been deposited and has moved on over to the other side of the bar. He does not recall the details as to which camps this happened, but he does remember it happened at the camp at mile 41.

There is no particular landmark at the Crossing of the Fathers, except that the banks are low and the river is accessible from either side. He does not recall any unusual characteristics of the river at that particular point.

The work on pages 1, 2, 3, 4, and 5 of Compl. Exh. 10, along the river and on the west side up to mile 50 or 51, was all done by him or members of his party, mile 50 and 51 being shown on Sheet 4. The work work above mile 51 was done by Trimble. The work on Sheet 5, or the river and part of Rock

Creek, he thinks was done by Trimble, the balance being done by Leech and Hayden who were members of his [Fowler's] party. (R. 3968–3970.)

The profiles shown on Sheet 52 indicate the fall of the river, giving the horizontal and vertical scales indicated on the plat, and from the starting point, zero, marked at Lees Ferry, the first one [profile] runs up a distance of ten miles, which means ten miles above Lees Ferry. The figure 3115, over on the right-hand corner, represents 3,115 feet above sea level. Lees Ferry is 3,120 feet above sea level (R. 3970); 3,120 feet represents the level of the surface of the water as it was on the day he saw it and would vary according to whether the river was high or low. The figure 3125, appearing on the map, represents a point 3,125 feet above sea level, that is reached at about mile 3, and that is the water level on the day on which he surveyed it. If there had been a sudden flood, or a higher stage of water, the elevation above sea level at that point would have been higher. (R. 3971–3972.)

A river continually changing, as does this river [the Colorado], the elevation of the surface of the water above sea level would depend entirely on the date on which the survey was made. It would have to be used in conjunction with the gage readings, and he believes they attempted to eliminate any sudden, abnormal stage of the river. (R. 3972–3973.) How does that represent any permanent condition upon which one can base operations subsequently? That

is, if, in order to explain the level, you have to know what stage the river was at, how does one accept that figure as anything definite to base operations on?

There are permanent bench marks on the banks along the river, although they would not appear on page 1, because the Coast Survey level party did not overtake them until they were some distance up the river. There is a bench mark near mile 28, on Page 2, which is permanently fixed and marked to designate its elevation above sea level as determined by a level line running along the river. This point is fixed by a bronze tablet set in the ledge, and from this bench mark the other matters which appear on the map can be accurately calculated.

Of course, the profile represents the level of water at the time of his survey and if the survey were made when the water were higher or lower there would be a different figure on the profile, but anyone going upon the land to investigate, would take the permanent bench mark and use the bench marks to determine the elevation of the water and use it in connection with the gage readings, or any other known factors or combination of factors regarding the conditions of the river at that time. (R. 3973–3974.) If one should go down there and see the bench mark, or have all these other figures, you could adjust these profiles in these maps to the situation. The same thing could be done while sitting here in Washington; it could be done in connection with the gage readings

taken at the same time that the survey was being made. (R. 3975.)

Cross-examination (Vol. 22, 3977–3982):

The longitudinal scale on Sheet 54, Exhibit 10, is 31630, which means two inches to the mile; and the vertical scale is one inch to twenty feet, so that the vertical scale is in feet and the longitudinal scale is in miles. If the map were brought to an actual scale or to an equal scale, both longitudinally and vertically, it would be necessary to divide by the ratio of one inch equals twenty feet and one inch equals one-half mile. (R. 3978–3979.)

If a true picture were depicted, say at Trachyte Canyon, or any rapids there appearing, it would be shown by drawing a line longitudinally the length of the country to be shown, and they would merely be shaded a little more at the elevated part than at the lower part. (R. 3979.)

His survey extends back from the river between Lees Ferry and mile 51, a distance of about ten miles, and in making the survey it was necessary for him to have a pack train, and when working back from the river he employed the pack train to deliver supplies. (R. 3980.)

The large boat on which he rode, on its initial trip and other trips, was equipped, he thinks, with a twenty-five horsepower motor. (R. 3980–3981.) It was equipped at first with a screw propeller and later with a paddle wheel, but he was not there when the paddle wheel was put on and he does not recall

that he rode on the boat when it was operated with the paddle wheel. (R. 3981.)

Recalled (R., Vol. 22, pp. 4066–4069):

His survey work from Lees Ferry in 1929, commenced in July and continued to August. (R. 4066–4067.)

"Q. Now, assume that on a certain day in August, you found the level of the river at a certain spot, and it appears that on that day the gage at Lees Ferry showed approximately 13½ feet. Now, you worked up the river from there, and ten days later you were working at a given spot, and taking a level, and on that day the gage at Lees Ferry showed 19½ feet—that is, a difference of 6 feet. What sort of an adjustment do you make on your profiles [Compl. Exh. 10]; because there is a difference in the river level of 6 feet, and if you have been working up day by day, how do you adjust that?

"A. I think I would adjust that—my recollection is that we adjusted some such differences as that arbitrarily in the field. For instance, that would mean an abnormal flow, caused by a sudden flood, and I think I took out several of those arbitrarily, and in a few days the river—that is reduced to the grade or the elevation at which we were working; say, when the gage read 13½ feet; in a few days it appeared that this was a period of the river gradually falling.

"Q. Now, I note, for instance, that in August there was one day—for instance, the 14th of August—

where the gage at Lees Ferry stood at 13.35, and along two weeks later the gage ranged right along 15, 16, 17, and 18 for nearly a week. That is a difference of from four to five feet. Now, that would be included in your profile, unless you adjusted it. How do you adjust it? I mean it was not apparently on a sudden flood, but it was a condition that was a very perceptible raise in the next two weeks.

"A. Well, in the case of a raise like that—in the case of a gradual raise we had no means of—if we noted it, but I do not recall that we made any change for that; as the profile shows a comparison as you work along—if the river is at a certain elevation during the day's work, the five or six miles of that profile along that day's work, while consistent with each other, the change between that and the next day would be applied; that would be consistent, and there may or may not be a slight inequality in the profile between the two days——

"Q. How far ordinarily would you go a day, working up from Lees Ferry?

"A. Well, from two to four—I do not not know that we made over four miles any day; two to four miles."

The SPECIAL MASTER. Well, I think I understand the situation. (R. 4067–4068.)

In the final preparation of his profile maps, he does not recall that he had before him the gage readings and he did not make any adjustments for gage readings. (R. 4068–4069.)

RAYMOND C. SEITZ

For Complainant

(Record, vol. 22, pp. 3982–4036)

He is of Washington, D. C., and is a topographical engineer, in the employ of the United States Geological Survey, and has been in their employ since the fall of 1902. He is not a graduate from a technical school but in the course of his work has been on several different rivers. (R. 3982.)

He has worked on the Pecos River in Texas, the Clarks Fork of the Columbia in Montana and Idaho, the Colorado River in Colorado and Utah, the Rio Grande in New Mexico and Texas, and the head of the Salt River in New Mexico. His work on these rivers was in connection with the preparation of maps and making surveys. In his work he used boats on the Clarks Fork of the Columbia; on the Colorado River and part of the Rio Grande. (R. 3983.) On the Rio Grande they started at the Colorado-New Mexico line with the boats and proceeded down the stream. (R. 3984.) He is unable to state just how far they proceeded down the stream.

He first came in contact with the Colorado River in the fall of 1911 at Grand Junction, Colorado, and worked from Grand Junction downstream to a point just below Castle Creek. The purpose of work was to make a plan and profile survey of the river. (R. 3984.) He was in charge of the party making the survey and used two flat-bottom rowboats, fourteen feet long with a four foot beam and a draft of not more

than two or three inches, the boats never being loaded. The party consisted of five, including himself. The boats were used in crossing the river and in going down the river from one point to another. (R. 3985.) They had with them camp equipment, but that was moved in wagons. (R. 3986.)

The Colorado river rises near Kremmling, Colorado, and for a distance of about one hundred miles flows through a mountainous country, and might be described as a mountain stream. At this point, which is above Glenwood Springs, the country is more or less open, and the width of the river will average about two hundred feet. The mountainous portions of the streams are very shallow. After you near Grand Junction it becomes deep. He did not make any soundings and has no records. (R. 3995–3996.)

From Grand Junction down a distance of 21 miles is in open country; numerous islands; the river is crooked and numerous side channels are encountered. The river is 200 to 400 feet in width. (R. 3996.) He personally went over that section of the river from Grand Junction downstream in boats. (R. 3996.)

Numerous readings were taken along the river to indicate its fall, and from Grand Junction down to the end of the first ten miles, the fall is 65 feet or 6½ feet to the mile. The map which he has indicates any abrupt breaks in the survey of the water surface but they are not classified as rapids. (R. 3997.) The character of the water in the first ten miles would be classified as swift waters. The fall of the river in the next ten miles is 56 feet and the character of the water

is the same. The fall of the river is gradual to mile 18.2 and then there is a drop.

After passing mile ten they entered Horse Thief Canyon at mile 24.5, and left the canyon and entered open country for a short distance down to mile 30. The fall of the river between mile 20 and mile 30 is 48 feet. The water is swift through Horse Thief Canyon with one abrupt drop at mile 23.3. (R. 3998.)

The drop of the river between mile 30 and mile 40 is 56 feet, and there is an abrupt drop at mile 34.8 and the rest of the water is swift. (R. 3998–3999.) Between mile 40 and mile 50 the fall of the river is 68 feet.

The Utah line was crossed at approximately mile 39.6. It was a distance of about 55 miles from Castle Creek, which is at mile 94. (R. 3999.)

The water between mile 40 and mile 50 is swift down to mile 47.3, where there is a decided drop, and at mile 48 there is another decided drop of eight-tenths of a foot to the mile. He recalls the Little Dolores River, and his map indicates that it is a perennial stream. (R. 3999.)

He did not go through West Water Canyon, but made observations from his traverse line along the bench a considerable distance above the water, and elevations of the surface of the water were taken at various breaks along the water surface. To the best of his remembrance, the survey started in the latter part of October and ran through November and a part of December, 1911. (R. 4013.)

He was able to obtain water readings down to mile 49, and therefore must have been able to get along the river bank. From thereon he went along the bank spoken of. (R. 4014.)

The boat was portaged throughout the canyon, being taken out at the head and put back on the river at Big Hole, which is at mile 56. No water readings were taken until they reached mile 55, but the fall of the river was calculated from mile 49 to Big Hole at mile 56, a distance of 7 miles, and the drop is 119 feet.

Compl. Exh. No. 503, is identified as a photograph of a section of West Water Canyon, showing the bench from which he made his observations. (R. 4014.)

Leaving West Water Canyon the river widens out and the country becomes more open. There are islands [in the river]. West Water Canyon ends at mile 59, and Castle Creek is at mile 95. From mile 56 to mile 59, the end of West Water Canyon, there is a drop of 20 feet. (R. 4015.) The drop in the river from mile 59 to Castle Creek is 146 feet. (R. 4016.)

The water is comparatively quiet down to mile 61.7, then there is an appreciable drop, which continues down to mile 63.

The mileage at Castle Creek is about 93.8 and is the point where the survey ended for the season.

He returned in the fall of 1912, and continued the survey down to the mouth of Green River, using boats from Moab to the mouth of the Green River.

The same two rowboats that they had on the upper river were used.

They did not use boats between Castle Creek and Moab, because the boats had been taken down to Moab, where they had been stored for the winter. (R. 4016–4017.) The boats were hauled down to Moab on a wagon. They did not use the boats because it would have taken more time to take the boats the short distance up stream [from Moab to Castle Creek] than it would to go along the road [from Castle Creek down to Moab]. He does not remember whether they rode horseback or went by wagon.

The survey from Moab to the junction commenced in October, 1912, and finished in December, 1912. (R. 4018.) Reading from the original maps of his survey, which he made in the field at that time, he states that there is a decided drop in the river at mile 76.4 and another at mile 74.4. The mileage on the map reads from the junction up the river. (R. 4019.)

The distance from the mouth of the Green River to Castle Creek is slightly over 79 miles. (R. 4020.)

The 10 by 30 flat-bottom boat of which he spoke drew 8 to 10 inches of water, loaded. He found it beached near the bridge at Moab, and put a frame-work of boards on it. It was equipped with no power, but was operated with sweeps. (R. 4021.) His intention was to use this boat as a house-boat, moving it daily, but on the second night of the second move it sprung a leak and sank. The boat was never named.

He made no observations on that stretch of the river with reference to the channel, sand bars, or cataracts, except when they were pulling it ashore and leaving shore.

All necessary supplies were taken from Moab with the party. (R. 4022.)

When they got through at the Green River they started back up stream and upon reaching the mouth of Indian Creek, they abandoned the river and followed Indian Creek to the Indian Creek Cattle Company's ranch, about thirty miles up. They did not go back up the river in the boats because it was exceedingly slow work, the large boat having to be towed, and also because the food supplies had run out. The large boat spoken of is not the one that sank.

Immediately after the first boat sank he sent a boatman back to Moab, to which place he walked, going from there to Thompson by stage, and then to Grand Junction by rail. At Grand Junction he had a boat constructed eleven feet long and a five foot beam and flat bottom. (R. 4023.) This boat loaded drew about ten inches or more of water. This boat was brought to the Colorado River, from Grand Junction to Thompson, by rail, and from there to the Moab Bridge, by truck, and from there down the river to the party. He did not have the boat brought down the river from Grand Junction because it would be too difficult for one man to handle so large a boat (R. 4024.)

Compl. Exh. No. 504 is identified by him as a picture of the 5 by 11 feet boat being towed upstream after leaving the mouth of the river [Green].

This boat was used for transporting provisions. It came down from Moab, however, unloaded, in as much as he had supplies with him at camp. The provisions that were in the boat that sank were taken out and put on a sand bar and picked up by the boat just spoken of. The rowboats were not used for hauling supplies. (R. 4025–4026.) On the trip back one of the rowboats was left at the mouth of the [Green] river, the other rowboat and the 5 by 11 boat were taken up to the mouth of Indian Creek, tied, and then left. (R. 4026.)

From the Indian Creek Cattle Company's ranch, the party traveled by buckboard, a distance of about 105 miles. The trip required two days. That was the last time he was in that section of the country. (R. 4026–4027.)

Pages 17 to 29, inclusive, of Compl. Exh. No. 10, are all survey maps prepared by him on the occasion testified to. Pages 58 and 59 of the same are profile maps also prepared by him. (R. 4027.)

He has been on no other sections of either the Green or Colorado Rivers.

To take care of rises in the surface of the river a point was set on the bank at the end of the day, far removed from the stream, so that it could not be disturbed. The next morning the elevation of the water surface was checked, and if there had been a rise the

amount of rise was used as a constant and deducted from his readings, the amount deducted being determined gradually, so that at the end of a day or two he would be back on his original basis. (R. 4028–4029.)

Assuming a rise in river continued for several days he had no way of determining how far or what effect that rise would have on the river below where he was working. He had to use his best judgment, by noticing that débris was being carried down the stream, and other indications. From time to time he corrects his data in order that it may be all tied into one survey. (R. 4029.)

He can not state whether or not that method is in accordance with approved engineering practice, inasmuch as that particular work was his first experience in river surveys in general, the work commencing the season before being his first on rivers. He has, however, worked on rivers since then. (R. 4029.)

The only statement that he can make as to how it is handled to-day is an experience that he had on the Clark Fork of the Columbia. He quit work there in the fall and next spring when he came down they had a freshet of ten feet. He simply waited until it had gotten down to within a reasonable distance of where it was when he quit the season before. On mountain streams the rise and fall is very sudden. (R. 4030.)

He can not state whether the difference in elevation between water in the narrow canyons and the open spaces beyond the canyons is less in low water

than in high water, because in his experience he has never had the opportunity of making measurements in order to determine that point. Offhand, however, he would judge that there would be a greater proportionate difference between the water level in the canyons and the open spaces below in high water than in low water. (R. 4030–4031.)

At the time he made the survey on the Colorado River there were no instructions from the Department to use the "rapid" symbol on the sheets, and for that reason he did not show any rapids on the plan sheet. The rise and fall in the water would only effect the map in so far as the contour interval was concerned. In this case the contour interval is 25 feet, and if the water should rise 25 feet it would cover that contour and would necessarily cause the river to widen out to the next contour. (R. 4031–4033.)

Cross-examination (R., Vol. 22, pp. 4033–4036):

His trip from Kremmling down to Glenwood Springs required about seven months time. He spent about two months on the Colorado below Castle Creek, from October to the early part of December [1912]. On his first trip when he got near the mouth of Castle Creek he went from there to Moab and from Moab to Thompson by stage, where he took the train, leaving his equipment stored with a man named Wilson at Moab. (R. 4033–4034.)

The equipment stored consisted of two boats and ordinary camp equipment, the instruments being

taken to the office. The equipment, including instruments, was all taken from Castle Creek to Moab in one wagon, and the road follows right along the river. (R. 4035.)

He had no previous maps or surveys of the river when he came down. (R. 4036.)

HERMAN STABLER

For Complainant

(Record, vol. 22, pp. 4036–4066, 4069–4075)

He is a civil engineer by profession, at the present time connected with the Government as chief of the Conservation Branch of the Geological Survey. (R. 4036.) The Conservation Branch of the Survey deals with the classification of the public lands, in respect of minerals, power, agriculture, and the leasing of mineral lands; the engineering supervision of power permits and licenses under the jurisdiction of the Secretary of the Interior. (R. 4037.)

His education included engineering training. Since that time he has been in professional work for the Government, entering Geological Survey in 1903. He has also done work for the Reclamation Service.

The survey of rivers is preliminary work necessary to classification for power purposes. (R. 4037.)

The profile sheets of the river included in Compl. Exh. 10 are intended to give a picture of the slope or grade of the water surface. The vertical scale of the profile is exaggerated in order to show clearly the differences in elevation and to visualize the actual conditions as they occur on the river. A difference

in elevation of one or two feet in a mile is not discernable to the naked eye, and therefore the scale must be exaggerated in order to depict these differences [in the river]. (R. 4038.) This is in accordance with approved engineering practice, and profile sheets for river work, and other purposes are drawn in that way. He knows of no better way in which they could be shown very satisfactorily in practice. (R. 4038–4039.)

In order to obviate the effect of changes in the stage of water in the river, it is arranged as far as possible to make the survey during the time of the year when changes are at a minimum. The profile that is finally drawn is made to represent the surface of the water at ordinary low-water stage. If a sudden change in stage occurs, this is taken care of from day to day by the topographer on the ground, or by applying a correction on the basis of gage stations that may be maintained along the stream. (R. 4039–4040.)

Some of the surveys that they have made, for instance, are corrected to a fixed stage—on the Colorado, or portions of it, a fixed stage of 10,000 cubic feet per second, taking into account with the readings of the gages up and down the stream, the cross section of the river at the place where the correction is made, etc., so that it will afford as accurate a picture as possible. (R. 4040.)

It has been his experience since he has been connected with the Department, that maps prepared in

this way are reasonably accurate, although not absolutely, but accurate enough for all practical purposes, especially as apply to water power and storage investigations. (R. 4040.)

He has crossed the San Juan River several times at Ship Rock and one or two points below, and has been at its mouth. He has crossed the Green River a number of times at Jensen and Greenriver, Utah, and has been on it in a boat through Flaming Gorge. He has traveled along the Colorado from Dewey Bridge below Cisco, down to Castle Creek, then by boat from Halls Crossing, in Glen Canyon, to Lees Ferry, from Boulder Canyon to the Needles, and from Bright Angel Trail, in Grand Canyon National Park, to the Needles. He has also spent a good deal of time in the office and used and studied maps prepared by others, and from his own observations worked on or criticized proposed plans of development of the stream. (R. 4041.)

The ultimate purpose of his study of the Colorado River was the preparation of schemes of development by which the water resources of the river can be used to the best advantage of everyone concerned, including the United States as a landed proprietor along the river, and normally will grant permits or licenses for the development for one purpose or another.

Compl. Exh. 505 is a map prepared for a report to be published by the Geological Survey, prepared by Mr. Follansby, our district engineer at Denver, showing a number of features of development and possible

development of the water resources in the basin of the Colorado River, above the mouth of the Green River. It shows irrigated land and proposed irrigation; developed power sites and power sites proposed for development, and a general comprehensive scheme of development of the whole river system. (R. 4041–4042.) In the State of Utah this map shows a little irrigated land in the vicinity of Moab; some proposed for irrigation on the Dolores River, a tributary of the Colorado near Monticello; and what is known as the Dewey site, a short distance below the mouth of the Dolores River. (R. 4042–4043.) That is intended primarily for river control—river regulation and power; the water, if and when used for irrigation, will be used below Grand Canyon somewhere for storage and power. The lower portion for power, and a few feet at the top for storage. There is no opportunity below that point to divert for irrigation in a practical way until they get clear below the canyon section of the river. They have also a suggested undeveloped power site, which would be flooded out if this reservoir were constructed on the Dolores River at its mouth.

The power site, in their terminology, represents the power of the river in its natural condition, without a dam; an undeveloped power site would be that. They ordinarily speak of it as a power plan, unless a development is made, although the term "site" is also used for the development. (R. 4043–4044.)

Between the Utah line and the mouth of the Green River the map shows no lands which could be irrigated from the Colorado River. There are, however, the two small areas that can be irrigated from tributaries, that is, considering gravity service without pumping. (R. 4044.)

Compl. Exh. 506 is a map showing the position of Green River from its source to its mouth. It contains substantially the same type of information that was included on the map previously discussed, showing irrigated land proposed for irrigation, developed and undeveloped power sites, and reservoir sites, all prepared by Mr. W. R. Woolley, for publication by the Geological Survey, Mr. Woolley being one of our hydraulic engineers stationed at Salt Lake City, Utah. (R. 4044–4045.) The material for the maps, both of which were completed in 1929, was gathered over a period of twenty years or more. The Flaming Gorge is in the State of Utah. The Flaming Gorge dam site, the primary purpose of which is for power, river control being a large factor, is located in Horse-Shoe Canyon. The figures 2 and 3 in circles just below the Wyoming line indicate undeveloped power sites just below Flaming Gorge, used to equate the flow of the stream at the Flaming Gorge site. (R. 4045–4046.) The circled figures 4 and 5 indicate power sites in Colorado at Split Mountain, and the areas on the map shaded yellow and green have nothing to do with the power site or the water from an irrigation standpoint, but are independent of those sites. The area shown in green is irrigated by water diverted

from tributaries, Brush and Ashley Creeks, although there might be a trifle of land irrigated by pumped water from the river. The area shaded yellow, which indicates proposed irrigation, might possibly involve some pumping from the river; the amount of water used would be small and would have no relation whatever to the power sites. There is a little proposed irrigation near Ouray [Utah]. The Ouray reservoir site, however, has been discarded because of more usable sites and poor foundation conditions there. These proposed irrigated lands, as those under irrigation, would obtain water principally from tributaries to the Green River. (R. 4047–4048.)

These dam sites were surveyed under authority of the Reclamation Service of 1902, and by Geological Survey, under general authority for investigation of water resources. Many of the surveys, however, were undertaken with a view to develop a comprehensive general plan of development for the whole river.

In the vicinity of Greenriver, Utah, is the most promising possibility of irrigation in Utah from the Green River. By diverting the water from a dam of considerable height, and supplementing by pumping, water could be obtained to irrigate a few thousand acres. (R. 4048–4049.)

Compl. Exh. No. 507 is the press relief, bearing the title "Utilization of the Green and Colorado Rivers." The paper summarizes the principal information as to irrigated and irrigable land, developed and undevel-

oped power sites, and developed and undeveloped reservoir sites, in the two reports by Follansby and Woolley, and for which these maps referred to were made. This paper was released February 28, 1929. (R. 4050.)

As indicated on Compl. Exh. No. 2, the first power site below the junction of the Green River with the Colorado is situated at about the foot of Cataract Canyon, and is known as the Dark Canyon power site. There is also a site right at the junction. If constructed, the dam below the cataracts would destroy the rapids in Cataract Canyon. The next power site down the river is in the lower end of Glen Canyon near Lees Ferry, which is a combined power and storage site.

On the San Juan River the first power site is located at Bluff and is a combination storage and power site. It seems to be the only indicated development on the San Juan River. The map shows no lands or no proposed lands to be irrigated from the San Juan River. (R. 4050–4051.)

There have been several heights proposed for the Boulder Canyon Dam, the one authorized, he thinks, is about 555 feet above the water surface, the elevation of the top being from about 1,200 to 1,250 feet above sea level. The back water indicated on the map would require a dam nearly 800 feet high at the proposed Glen Canyon dam site and would flood out the Dark Canyon site.

All of the improvements testified to on the Green, Colorado, and San Juan Rivers are part of a general

scheme of improvement, the purpose being to derive the maximum possible benefit from the water resources of the basin, both for the United States and the individual States. (R. 4051–4053.) These improvements are interrelated, in as much as each reservoir in the headwater region would benefit every power site below by equalizing or tending to equalize the flow of the stream.

The flow of the Colorado varies from less than 2,000 second-feet to 200,000 or 300,000 second-feet during the year, and by this development the flow will be brought to a common means of 15,000 or 20,000 second-feet, which would make possible a much higher development of horsepower during the low-water season. This equalization of flow would be a help to irrigation on the lower Colorado or the Imperial Valley, where irrigation is practiced twelve months in the year, but in other regions where irrigation is confined to two or three months in the summer, equating the flow would not increase the possible benefit to irrigation. But the operation so that the maximum benefit will be derived for both irrigation and power has to be managed. (R. 4053.)

At the time he made his trip on the Colorado River, commencing at Halls Crossing, he went by train to Richfield, Utah, and from there overland by automobile and truck to Browns Ranch, a distance of 110 miles from Richfield, and from there traveled by wagon, having two four-horse teams and wagons.

On the trip down the river sand bars were encountered a number of times, the river being so muddy

it was impossible to see the channel clearly. This trip was made in the early part of September, 1922. They were on the river, as he remembers, ten days, and the trip ended the 16th of September. (R. 4054.) There was only one place on the river where it was very evident that bed-rock extended clear across the river, at a very shallow depth. The boats scraped bottom in the best channel that could be found, and the water must have been less than a foot deep in that place for a distance of fifty feet or more. He remembers a rapid at the mouth of Aztec Creek, because it was the one rapid where they took particular care in running. There were quite a number of small rapids through Glen Canyon, but only three that he remembers particularly. He carried a map with him on the trip and made notes on it. (R. 4055.)

The boats used were those described on the Davis, Birdseye, LaRue, Thomas trip. The map he carried was a print of the map of the survey made in 1921, and it is noted on the map that the trip started September 8th, the first one commencing at mile 118 above Lees Ferry.

He noted on the map what he considered a rapid. A rapid is a matter of definition; that is, really his use of the word would refer to any narrowing of the river that would cause a change in slope and an increase in velocity that would be sufficient to cause waves or wavelets on the water. "You might call them riffles." (R. 4055–4056.) His definition of rapid might or might not include the presence of rocks or

bars in the stream; it was simply a rapid stretch in the stream indicated by wavelets and a rise in velocity. That is the definition of the ordinary man on the street; that is what he thinks of. In contrast, for instance, on a trip down Grand Canyon, they did not consider anything a rapid that would not swamp an open boat. The conditions were very different there. (R. 4057.)

The second rapid he encountered was at mile 116.5 above Lees Ferry and the third at mile 115.9; the fourth at mile 113.2; the fifth is bed-rock rapid at 112.1; the sixth at mile 110.5; the seventh at mile 109; and the eighth at mile 108. He then got tired of marking the little rapids, which were not of any material importance. He had eight within the first ten miles of the trip and about that proportion continued down to the mouth of the San Juan. From there on they were fewer on down to Lees Ferry. (R. 4057.)

He has also indicated a rapid at mile 68 just below the mouth of Aztec, and notes "Rapid," the narrowest point on the river at low water. (R. 4058.) This was one of the three most difficult rapids on that stretch of the river, and great care was necessary to avoid swamping the boat. Of the other two, one was near the mouth of Oak Creek, at mile 71, and the other, that was called Whirlpool Rapids, is not far below Halls Crossing. At this rapid all the boats shipped some water. (R. 4058.)

Sand bars were of frequent occurrence. They would often run into them unawares and get hung up.

He remembers once they were stuck for several hours. He made a notation on that point, just above mile 61. They were traveling down at a little too great a speed, and were then pretty well up on the bar, and it took them quite a while to get off and get started down the river again.

In a silty river like this, where it widens out, there is the tendency for a bar to form in the middle of the river, with a channel on either side, and it is pretty hard coming down the stream, with muddy water, to tell which channels to take, and to tell whether the channel you take will carry you on through or not. (R. 4058–4059.)

Sheet 16 shows the stream flow for September 8th to 16th. On this trip they had four sturdily constructed boats, 18 feet long, 4-foot beam, that had a draft of 6 to 8 inches.

His trip in September, 1927, between Cisco and Moab, Utah, was made by automobile. He made no notes relative to the river and what he might say would be entirely from recollection. (R. 4059–4060.)

Having in mind a trip he had taken through the Glen Canyon, and others, he did observe more or less carefully the general character of the river, with a view to the possibility of traveling on it by rowboat and canoe, and it would seem to him it would be practicable to travel down it in the stretch that way. There were a good many curves, quite a lot of rough water, quite a lot of shallow water, some rocks that would have to be watched out for. (R. 4060–4061.)

He saw no boats whatever on that stretch of the river.

The instructions to the topographic engineers with reference to showing rapids on their topographic maps are by conventional symbol—their instructions are to use the contour crossings every five-foot crossing. But the conventional rapid symbol is quite immaterial, and the instructions are not to put such a symbol on in general. They depend upon the contour crossings and the construction of the profiles to show that. (R. 4061.)

There is no conventional definition given engineers by the Department as to what is or what is not a rapid or a riffle, so far as he knows. Each man uses his own judgment as to what he shall term a riffle or a rapid. (R. 4061.)

He is in a general way acquainted with oil permits issued on the Colorado River between Moab and its junction [with the Green River]. In granting these permits no attention whatever was paid to the river, some of the permits at a point 12 or 15 miles below Moab actually crossing the river. (R. 4062.)

The question of the sediment in the river has been given more or less casual consideration in connection with building of dams and attempts have been made from time to time to determine the amount of the sediment at quite a number of points. The earliest attempts of that kind were made in 1905 or 1906, and more recently a rather comprehensive

series of measurements have been made at a number of points. (R. 4062–4063.)

If and when the dams are built the greater part of the sediment carried by these streams will be deposited in the upper part, at the headwaters of the dam, at first, gradually fill down to the dam itself. The reservoir capacity of the dam will be materially decreased and there will be a rising of the river bed on the upper end of the reservoir. There would, of course, be no change in the normal flow line, or the water surface of the river. (R. 4063.)

This map, Compl. Exh. 9, is in two parts. One portion is a plan from Lees Ferry upstream, on the main stem of the Colorado, to Grand Junction, covering the Green from its mouth to Green River, Wyoming, and the San Juan from its mouth up to 10 or 12 miles above Goodridge—well, to Chinle Creek. The mileage above Lees Ferry seems to be indicated on all three streams. The power site reserves are shown. The power site classifications, reservoir site withdrawals, and projects for which application has been made to the Federal Power Commission. (R. 4063–4064.)

The meaning of "power site reserves" are lands withdrawn from entry under the land laws, to be used for development and use under the water power laws. These withdrawals were made under the act of 1910, authorizing the President to withdraw lands for public purposes. There is a legend on the map explaining the coloring thereon. (R. 4064–4065.)

The second portion of this map, Compl. Exh. 9, contains a profile showing the slope of the Colorado River, the Green, and the San Juan. (R. 4065.)

Cross-Examination (Vol. 22, pp. 4065–4066):

The squares on Complainant's Exhibits 505 and 506 represent townships of approximately thirty-six square miles each. (R. 4065–4066.)

Recalled (R., Vol. 22, pp. 4069–4075):

It is his understanding that on that section of the river, for instance between the mouth of the Green River and Lees Ferry, the adjustment was made (in correcting or rechecking topographer's notes) to the uniform stage of 10,000 second-feet, in the light of gage height readings at Lees Ferry. The topographers' field sheets and notes in every case show the water elevation, as indicated by him. These were then adjusted to the gage readings at Lees Ferry or of the gages on the streams that affect that particular section of the river involved. That would represent a 10,000 second-feet stage, in the light of the cross-section of the river at the point where the observations were taken, as well as the change in the stage. That would mean a lowering or raising accordingly. Where the river as at a stage of 15,000 second-feet, for instance, it would mean bringing the level down; to where it was 5,000 or 6,000 second-feet it would be up so as to represent a uniform stage of 10,000 second-feet the whole way. (R. 4070–4072.)

This was done after the original draft of the profile, but before final publication.

The maps contained in Complainant's Exhibit No. 10 were printed in 1926 and would indicate that the checking was done before they were printed.

All of these gages would be taken in consideration in making corrections, and they were taken into consideration in making adjustments on these maps.

The information you would have on it then would be the topographers' notes, or, at least, their gage and the general knowledge that a flood on the San Juan would make a very great difference on the water level of the Green and Colorado. (R. 4073.)

The adjustment would not change the general picture of the profile at all, because the slope or gradient in general is such that a minor fluctuation makes very little difference in it. At some particular point it might make a difference of a few feet, and would change the slope a few per cent at that particular place. That brings him to the point of the change in the slope of a rapid between low stage and high stage. (R. 4074–4075.) The general type of the slope would, of course, vary from low stage to high stage. The rapid will appear on any profile, however, as a rapid. It would not appear as more of a rapid the higher the profile went. The rapid would appear shorter and sharper at a low stage, and longer and flatter at a high stage. There would be a difference in appearance; yes, sir. (R. 4073–4075.)

CHARLES ARTHUR BISSELL

For Complainant

(Record, vol. 22, pp. 4075–4084)

Resides at Chevy Chase, Maryland, a civil engineer by profession, and is at present employed in the Bureau of Reclamation, Washington Office, having been so employed since 1908.

Previous to entering the employment of the Government he was graduated as a civil engineer at the University of Texas and had some experience in railroad construction work.

Compl. Ex. No. 2, a map which was prepared under his supervision, was prepared from data obtained by actual survey made by engineers with the Reclamation Bureau and with the 1920 census, the patterns in green being obtained by the surveys and the solid green from the census. (R. 4075–4076.)

The information as to the Reclamation Service project was obtained over the period commencing in 1902, while the information as to the private irrigated areas in solid green was compiled under the direction of A. T. Teale, for the Census Bureau in 1919. The date of the maps is 1928.

The surveys on the Colorado River were among the first undertaken by the Bureau of Reclamation. (R. 4077.)

One of the early reconnaissances was from a point near the present Boulder Canyon dam site down the

river in search of irrigable areas and possible reservoir sites. (R. 4077–4078.)

The only information shown on the map near Moab is certain private irrigated areas. Near Greenriver the Bureau made investigations of possible irrigated projects. The data was gathered in the last five or ten years.

His Department has to do with dam sites only when power development is incidental to irrigation. (R. 4078–4079.)

The map carries as a matter of information a number of power sites that they knew of at the time of the compilation of the map and that had been considered as possible power sites. They do not represent in all cases, or in the majority of cases, surveys for power development made by this bureau. For instance, they have several power sites from Flaming Gorge on down the river marked with an arrow as power sites. But these power sites, when they have been investigated by the Reclamation Bureau, have been investigated primarily as irrigation reservoirs, and only incidentally as sources of power. (R. 4079.)

The Flaming Gorge was like the other reservoirs that are shown on this map [indicating]—was considered as a possible storage for the lower basin, not for use of the stored water in the upper basin to any great extent, if at all. (R. 4079.)

As far as he knows the Flaming Gorge project is a power project but was investigated years ago as an irrigation reservoir. The Flaming Gorge project is

part of the equalization system and as such is related to the other dam and power sites on the Green and Colorado Rivers below Flaming Gorge. (R. 4080–4081.)

The proposed Ouray, Utah, dam site was one of several reservoirs forming a scheme of replacement for the Boulder Canyon storage, in case the Boulder Canyon should prove unfeasible, but the Ouray site itself proved unfeasible because of foundation conditions.

The Glen Canyon site is proposed for complete control of the river, the flow to be utilized for both irrigation and power purposes. (R. 4081.)

The Bluff site is to provide control of the San Juan River and would serve the purpose of eliminating considerable silt that comes down the river, and also furnish storage for possible power development. The San Juan River is considered one of the principal sources of silt that causes much trouble in the Colorado River, and if that could be controlled it would prolong the life of the reservoirs built further down, either at Glen Canyon or at Boulder Canyon. (R. 4082.)

Cross-examination (Record, Vol. 22, pp. 4083–4084):

The purposes of these dam sites are similar to the purpose of the Boulder Dam, as expressed by Congress in the proposed Boulder Dam Act, and they were investigated by the Bureau of Reclamation, prior to the determination of the feasibility of the Boulder

Canyon Dam. He does not believe that the Boulder Dam, from a scientific standpoint, would interfere with the construction of the other dams further back up the river, but the Boulder Dam will supply the same sections that might have been in part supplied by the other dams. (R. 4083–4084.)

FREDERICK R. DUDLEY

For Complainant

(Record, vol. 23, pp. 4085–4093)

He resides at Livingston Heights, Virginia; is a lawyer by profession; and is connected with the Reclamation and Right of Way Division of the General Land Office.

Compl. Exh. No. 9 represents certain withdrawals which have been made by the Government. He is familiar with the map and has checked it with the withdrawals, being designated on the map by number and by color. The reclamation withdrawals are designated by numbers in yellow; the power site withdrawals in red; and power site projects in green; the applications actually having been filed with the Federal Power Commission.

Compl. Exh. No. 508 to No. 534, inclusive, are withdrawals for reclamation purposes made under the Reclamation Act of 1902. The reclamation withdrawals are all made by date, and not by number; the power sites are by number. There is no designation of the withdrawals on the map except by color. (R. 4088.)

Compl. Exh. No. 535 to No. 557, inclusive, are power site withdrawals and power projects, colored in red and green, respectively. The power site withdrawals are also designated by numbers on the map, as in "Power Site Reserves 33 to 41, inclusive." (R. 4089.)

The status of lands which are withdrawn for power sites and reclamation are fixed by law, and the act under which they are withdrawn appears in the withdrawal. (R. 4092–4093.)

WALTER T. PAINE

For Complainant

(Record, Vol. 23, pp. 4093–4104)

He resides at Washington, D. C.; is in the employ of the General Land Office as cadastral engineer; and has been so employed for forty years. (R. 4093.)

He is familiar with the instructions of the General Land Office, Department of the Interior, with reference to the making of public-land surveys.

Pages 212 and 213, Sections 226, 227, 228, 229, 230, and 231, entitled "Meandering," and included in "Manual of Instructions for the Survey of the Public Lands of the United States, Washington, Government Printing Office, 1924," received in evidence. (R. 4094.) The sections referred to are the sections to which public lands are now being meandered. The meanders are run up against a river or other body of water. (R. 4094.)

He is familiar with the provisions of the instructions with reference to making meanders. In respect to the details that are outlined in the instructions, they are more specific in their last manual than the previous manuals contained. There were manuals that were issued as early as 1885; another in 1881; another in 1890; another in 1894; another in 1902. The one he exhibits is known as the Manual of 1916. As time has gone along, in the instructions which were issued for the surveying of the public domain, it has come about that attention has been directed to more particular means in determining the areas of public lands subject to public survey and the manner in which they would become subject to survey as time has developed the necessity therefor—largely, of course, in connection with our experience in matters that might have been before the Courts, where perhaps some question had not previously been taken care of in the manner in which the Courts wanted to interpret the law—they have followed the decisions of the Courts, particularly with reference to the details, and as our experience indicated the necessity for it. (R. 4095.)

Page 216, of the Manual states:

> Navigable rivers and bayous, as well as all rivers not embraced in the class denominated navigable, the right-angle width of which is three chains and upwards, would be meandered on both banks at the ordinary mean high-water mark, by taking a general course the distance of their sinuosities.

To the best of his recollection, the earliest manual that required streams whose right-angle width was three chains and upwards—the earliest instructions with reference to that were about 1890. Before that it had been left to the discretion of the surveyor, and it was determined that in 1890 it was necessary to define with particularity the circumstances under which streams should be meandered and this segregated from the mass of the public domain. A chain is 66 feet; three chains is practically equivalent to 200 feet. (R. 4096–4097.)

The chain used by government surveyors is called the "Gunter's Chain" and is sixty-six feet in length. That instruction standardized the surveys. (R. 4097.)

Cross-Examination (R. Vol. 23, pp. 4103–4104): (*Recalled* (R. 4137–4142)):

As requested, he brought four volumes that are the earlier manuals that were in use and followed by the Department in the survey of public lands. The manual bearing the date of 1881 was in force from its date up until 1890. There was an earlier manual than this one, of 1855, but the general principles with reference to the detail which should be observed in meandering was a matter of gradual development. Each manual as it came out would indicate a little finer degree of observation of the character of the stream. As he remembers, the manual of 1881 did not provide for the width of nonnavigable waters or streams and the matter was left more or less to the

discretion of the surveyor as to whether he should meander or not.

As far as published rules in force in the Department concerned, the provisions with reference to meandering contained in the manual of 1881 were substantially like all prior manuals or rules of operation. It was not until 1890 that there was any designation of width of nonnavigable streams that were to be meandered. (R. 4137–4138.)

All of the sheets in Compl. Exh. No. 607 carry a part of the Green River. The first sheet, indicating meanderings of the Green River, was surveyed in November or December, 1881. All of the other sheets give the dates of the meanderings of the sections of the Green River, the data appearing at the bottom below the map itself.

Compl. Exh. No. 606 contains sheets giving similar information to that given on Compl. Exh. No. 607, except that the sheets in Exhibit No. 606 relate the Grand River, or that portion of the Colorado above the mouth of the Green River. (R. 4139–4140.)

HUGH V. CAMPBELL.

For Complainant.

(Record, Vol. 23, pp. 4104–4114.)

He resides in Arlington County, Virginia, and is chief of blocking section in the land division of the Indian Office, Department of the Interior, having been with the Interior Department since 1905, and with the Indian Office since 1910. (R. 4105.)

(After further discussion:)

Compl. Exh. 70 is a black and white map prepared to show what they term the Navajo country, in Southern Utah and in Arizona and a part of New Mexico. It was compiled by a draftsman from General Land Office maps and survey data, as indicated on it. The date with the compiler's name is 1926.

There have been changes, since map was published as to that tract in Utah west of the 110th meridian, and south of the San Juan and Colorado. These changes are included in Compl. Exh. 71, and consist of Orders.

The map, Compl. Exh. No. 70, that is in evidence, shows that the territory in Utah west of the 110th meridian, was restored by Departmental Order of July 17, 1922, when, as a matter of fact, that is not the correct status of the land at the present time. (R. 4110-4111.) On February 19, 1929, the Assistant Secretary of the Interior approved the Indian Commissioner's recommendation to withhold the lands in the territory he has just referred to, south of the San Juan and west of the 110th meridian, from further disposition, with a view to obtaining a permanent withdrawal for Indian purposes by Congress. The purposes of the withdrawal—all of them are embodied in the letter which appears in Compl. Exh. 71, dated January 21, 1929, signed by Charles H. Burke, Commissioner. (R. 4112.)

Compl. Exh. No. 71 contains every order and every proclamation of every kind and character on file

relating to the status of the territory described in the original Executive Order of 1884.

CHARLES A. OBENCHAIN

For Complainant

(Record, Vol. 23, pp. 4162–4166)

He is Supervisor of the General Land Office, and has been such since 1892. (R. 4162–4163.)

He had a call for the preparation of this map Compl. Exh. No. 4 showing these three rivers (the Green, Colorado, and San Juan, and all filings, entries and selections affecting the lands or abutting on these rivers, and also all disposals, including filings, entries, selections, and patents. They took their records, tract books and otherwise, and obtained the data of the different kinds of filings and entries. And after they had that compiled, got the data all together, they had this map first laid down by the rivers, and then showed these withdrawals. And in each one of these legal subdivisions they put down the nature of the claim. For instance, this O. P. here means "oil and gas permits" under the Act of February 25, 1920, issued by the Interior Department. The other things like the A. P. means "oil application for permit," at the time this map was prepared the permit itself had not been issued for. But all of these O. P. mean "oil and gas permits" in existence at the time they made this map. (R. 4163.) The map [Compl. Exh. No. 4] was made about two years ago. The date is not given on the map.

The letters M. P. means mineral patent; O. L. is an oil lease issued by the Interior Department; S.

M. L. indicates State mineral lease issued by the State of Utah, covering the bed of the river only. The letter S. indicates State land or State selections. In other words, the legend covers all classes of disposals shown on map and filings, where the land is not disposed of, and the legend is a correct statement of the Government disposals, filings, and grants. (R. 4164–4165.)

Cross-examination (R. Vol. 23, p. 4166):

He cannot tell, without going into the records, how early any of the patented lands indicated on the map were patented.

The oil and gas permits marked on the map are the same as those received in evidence in the morning, and are printed on the same forms, except the description. (R. 4166.)

WENDELL M. REED

For Complainant

(Record, Vol. 23, pp. 4167–4178)

He resides at Washington, D. C.; is a Civil Engineer by profession, and is at the present time Supervising Engineer of the United States Indian Service, and has been so employed since 1928; as Chief Engineer from 1912 to 1928. (R. 4167.)

He is generally familiar with Indian reservations, including the Navajo Reservation in the States of Utah, New Mexico, and Arizona.

There have never been any irrigation projects contemplated from the San Juan River, covering any of the lands of the Navajo Indians in the State of

Utah, nor of the reservation in Arizona. There is some, however, in New Mexico.

The head gate for the canal where these lands are proposed to be irrigated is located at a point known as the Hog Back, five or six miles east of the Ship Rock School or Agency. It is a small project now under development, covering about 4,000 acres and contemplated to reach about 7,000 acres. It is entirely within the State of New Mexico. (R. 4168.)

Construction was in progress in 1912, but has not yet been completed. This project would take from the river probably no more than seventy-five second-feet. (R. 4169.)

Cross-examination (R. Vol. 23, pp. 4169–4172):

He has been at the place known as the Four Corners and also knows of the project called Turley Project, which begins in Colorado. He doesn't know of any other projects contemplated, except the Turley Project.

It is possible that were it not for the existence of the Navajo Reservation, a project like the Turley Project might readily have water diverted on to the lands in the Navajo Indian Reservation. He said that was possible, but he did not find it was feasible. He is supposed to be an expert on those subjects. (R. 4169–4171.)

Just using the matter of levels, as to a control, of course, a storage project is feasible on the San Juan River, but so many unsound engineering principles enter into this that would not consider the control

project as it was submitted by Mr. Turley, and as it has been submitted since by the State Engineer of New Mexico, as a feasible project. That something might come out of there is quite probable. But nothing to the extent of along the line that has been outlined in either one of those schemes. (R. 4171–1472.)

Redirect examination (R. Vol. 23, pp. 4172–4174):

The lands referred to lie in the Navajo Indian Reservation, south of the San Juan and east of the 110 meridian. There is an immense acreage there; probably, beyond the available water. (R. 4172.) There is an immense acreage in there—much, probably, beyond the available water. Just what part of all of that could be irrigated he could not tell you. And he only testified as to general levels. I mean by that, by a diversion of water high up on the stream, as Turley intended it, the levels would permit them getting down there, but there are a great many obstructions in the meantime that you would have to overcome in reaching them. You are meeting with arroyos, and not hogbacks, but obstructions that would have to be tunneled, land uprisings, and you are passing in the meantime some immense washes, and the elevation to which Turley contemplated in his project, you would have structural difficulties in many places. Now, he has not looked at his report in several years, and he is not in a position to go into details about it. He did look over

the New Mexico Engineer's a few years ago, but all of this is now more or less hazy in his mind, but he knows that at the time of study he characterized as rather dreams, at least, to the extent that they contemplated. (R. 4172–4173.)

In connection with any irrigation of the Navajo land in Utah, it would be more or less of a guess to state where the dam site would be located, without a thorough study of the contours. These lands are located in the southeast corner of Utah. (R. 4173.)

The Indian lands that are being irrigated are in the northeast corner of New Mexico, and come nearly to the Utah line.

The lands [in Utah] to which he refers would be down the river below the Four Corners. (R. 4174.)

SELDON SPENCER NYE

For Complainant

(Record, Vol. 24, pp. 4181–4194)

He is of Washington, D. C., a geologist by profession, and is employed by the United States Geological Survey, as assistant geologist.

He is a graduate of Harvard University, having received an A. M. degree in geology in 1926. (R. 4181.)

On September 26, 1926, he started on a trip on the Green River at Greenriver, Utah, in a sixteen-foot rowboat, equipped with a twin-cylinder Evinrude motor, in company with Mr. E. T. McKnight, for the purpose of mapping the geology in the canyons of the Green and Colorado Rivers.

The boat was operated alternately by Mr. McKnight and himself, the motor being used very little on the downstream trip, inasmuch as they were not trying to make any special speed, and the motor was unattached and in the boat most of the time. (R. 4182.)

A great deal of difficulty was encountered in the first twenty-one miles between Greenriver and the mouth of the San Rafael because of numerous rapids, and they were in the water most of the time trying to get the boat down stream. The trip from Greenriver to the mouth of the San Rafael required three days' time and most of the trouble encountered was at the mouth of the San Rafael, where it was necessary to wade up and down the stream several times and drag the boat over rocks and gravel to get it down stream, because at that point the channels were so divided it was very difficult to find one continuous channel where the boat would float. (R. 4183–4184.)

Between the San Rafael and the junction of the rivers there was only one riffle that was at all difficult, it being seven or eight miles above the junction. A great deal of trouble, however, was experienced in getting stuck or avoiding getting stuck on sand bars. They were in the water most of the time trying to find a continuous channel along that stretch. The total trip from Greenriver to the junction required eight days' time. (R. 4183.) The boat was stuck a good many times a day; hardly an hour passed but that it was necessary to get out and wade the stream

to find a channel deep enough to float the boat. (R. 4184.)

After reaching the mouth of the Green River they continued on up the Colorado River to Moab. The Colorado River being narrow and the fact that there had been a rain storm increased the depth of the water in the stream about a foot and a half, so that little trouble was encountered except at the slide, a short distance above the junction, at which point the motor had barely enough power to move the boat ahead. (R. 4184.) Beyond the slide some difficulty was encountered with whirlpools, but nothing serious. At one place, fifteen or twenty miles above the junction of the rivers, considerable difficulty was had with sand bars. The most trouble encountered on the trip up was about a mile below the Moab Bridge where the river goes into the Canyon. That stretch of a mile took them about two hours to boat. They arrived at Moab October 13, 1926. The boat with the Evinrude motor attached drew about one foot and a half of water and the motor was fixed stationary to the boat. (R. 4184–4185.)

Progress of the boat was slow enough so that the geology could be mapped, although stops were made at several points, one stop being for two days to measure a section of the formation exposed.

After reaching Moab the boat was stored and that is the last time that he has been back on the river. (R. 4186.)

Cross-Examination (R. Vol. 24, pp. 4187–4194):

He remembers the date of leaving Greenriver, Utah, September 26, 1926, because it was the morning after the Dempsey-Tunney fight. (R. 4187.) He knows the date he arrived at Moab because the total trip required eighteen days on the river. He is unable to give the exact location of the place where he stopped two days to take a geological section, but it was some eight or twelve miles above the junction of the rivers.

They stopped comparatively little to do mapping, most of the stops being to examine formations, this being done quite frequently, but they did not stop every day to examine the formations because they had been studied from the top. (R. 4188–4189.) He would judge that they landed three or four times a day on an average.

Neither he nor Mr. McKnight had ever been on the river before and had no knowledge of the location of channels.

In studying the geology it was not necessary to travel along close to the shore. They were trying to follow the deepest channels of the stream, one guiding the boat while the other did mapping. Their progress was so slow that they could do that. They could not see where the deepest channel was and would get fooled quite often. (R. 4189–4190.) At the point they had to wade the entire river, they would find one channel deep enough to float

the boat; that would end, then they would have to drag it across where it was very shallow and wade some more; right at those places they had to drag the boat most of the time. The channels were not separated; they were sort of interlacing channels. (R. 4190.)

The landings made, included those stopped for meals and for camp at night. He is unable to state any specific facts as to the exact time spent on the river. (R. 4191.)

The motor was not used going down the first stretch of the river because they did not want to damage the propeller. That was between Greenriver and the mouth of the San Rafael and they did not use it from the mouth of the San Rafael down to the junction, because they wanted to save gasoline chiefly. They did not have an anchor on the boat.

On the trip they had eighteen or twenty days' supplies; each having a cot and bed roll, together with gasoline, oil, instruments, and when they started out, a couple of kegs of fresh water. (R. 4192–4193.)

It required ten or twelve days, approximately, to go from Greenriver to the junction and six or eight days to go from the junction up to Moab, it being a much shorter stretch going upstream to Moab. They did not stop as often going upstream to Moab as going down the Green River to the junction, inasmuch as they had less occasion to stop on that trip.

The mapping going up was about the same as going down the Green River, but he did not have to stop to study the formations. (R. 4193.)

He came from Roswell, New Mexico, to testify in the case, and had made only the one trip on the river. (R. 4194.)

Further Examination (R. Vol. 24, p. 4194):

This geological work was done in connection with the studies of oil and gas possibilities on the area between the Green and the Grand, south of the Denver & Rio Grande, mapping geology and studying the structure. (R. 4194.)

JOSEPH A. ROSS

For Complainant

(Record, Vol. 24, pp. 4195–4276)

He resides in Pennsylvania, is fifty-seven years of age and first came to the State of Utah in 1886, where he settled at Greenriver as a boy and worked in the roundhouse as wiper on the Denver & Rio Grande. (R. 4195.) He remained in Greenriver most of the time since 1886 until 1916.

He made his first trip on the Green River in 1889, in a flat-bottom skiff, or rowboat, fifteen or sixteen feet long and three feet wide, which with a load drew probably six or seven inches of water.

Mr. Wm. Guyger accompanied him on the trip in his boat. There were other boats in the party, however, about the same size as the one described, and all together there were six men in the party. (R. 4195–4197). The trip was made for the purpose of hunting, exploring, and the like and they went down the river to a point called Horse-Shoe Canyon, about fifty miles below Greenriver, Utah. The trip was a

pleasure trip and they made a lot of fun out of it, paying little attention to the work they did. (R. 4197.)

Between Greenriver and the mouth of the San Rafael they had difficulty in getting over shallow gravel bars, which required considerable effort and labor. It was not smooth sailing. They had to stop and navigate by different methods. When they drifted onto the shallow bars they would get hung up and have to get out and push the boats off. Sometimes they could stay in the boat and push off with the oars, other times they would have to get in the water. The trip was made in September during the low stage of water. The boats were brought back up stream by rowing and towing. (R. 4198.)

His next trip on the Green River was made in 1903. As he recalls, it was in July, just after the spring freshet, and the river was receding to the low level. On this trip he had a flat-bottom scow-shaped boat about sixteen feet long and three and a half feet wide that would draw five or six inches of water. He did not have much of a load on the boat, a little powder and fuse, probably not over five hundred pounds. He did not have much trouble on that trip, getting along very well, the boat having a light draft and the water not quite so low. (R. 4198-4199.)

They encountered some sand bars on the way down, but, as before, were able to push off with the oars, although at times it was necessary to get out into

the water and push off. The boat they went down the river in, they tore apart and used for lagging and came back in another better-built boat. This boat they rowed and towed back up the river. (R. 4200.)

He obtained the boat he came back in from a family named Valentine, who lived at Valentine's Bottom, his work being in a prospect probably eight or ten miles above. His work was on the East side, or left-hand side of the river going down. (R. 4201.) He towed the boat in this manner: They used two lines, one line to the bow and one fastened to the boat near the stern of the boat, that is, for turning the boat in and out as you are walking along the shore, to throw the boat out into the current; usually about a fifty-foot line on each, bow and stern. (R. 4201.)

In September, 1863, he made another trip down the Green River for the purpose of bringing the Valentine family up to Greenriver, Utah. On this trip he went down the river in a flat-bottom rowboat sixteen feet long and four feet wide that had a draft of from three to four inches. He obtained this boat at Greenriver, Utah, where some trapper had left it.

As he recalls, they had pretty good sailing going down that trip, now and then hitting a sand bar, which invariably happens because he can't read the bars all the time on any trip. (R. 4202.)

In going back up the river there were Mr. and Mrs. Valentine and their daughter, Miss Eve Valentine, now Mrs. Ross, and his sister, now Mrs. Howland.

The distance from Greenriver, Utah, to Valentine's Bottom is about ninety miles. The water was at the

low stage when the trip up the river was made. It is always low in the latter part of July, August, and September. The trip consumed about seven days' time. They did not get all the way to Greenriver, however, getting only as far as Wimmer's Ranch. (R. 4203.) They did not go all the way to Greenriver, because they were too heavily loaded to go up over the swift water and gravel rapids. They got up as far as Wimmer's Ranch by rowing with two sets of oars at times towed with ropes. After arriving at Wimmer's Ranch the party went to Greenriver, overland, by wagon, and he, Ross, rowed and towed the boat back up to Greenriver. (R. 4204.)

The Valentines had been living down at Valentine's Bottom one year, from September to September. While there, Lee Valentine, a son, would sometimes go to Greenriver, Utah in a boat and take supplies down in the boat. These trips would be made throughout the year.

In November, 1893, he made another trip down the river for the purpose of taking Mr. Bullock, who owned the prospect, down to look over the situation. On this trip he used practically the same kind of boat that he had used on the other trips. This boat drew around six or seven inches of water loaded. (R. 4204 4205.)

Between Greenriver and the mouth of the San Rafael they made one or two groundings but nothing serious. Below the mouth of the San Rafael they had trouble with sand bars and found that the water was

too shallow to get the boats over them, and it was necessary to get out into the water and push the boat off.

They remained at the prospect probably four or five days and then returned to Greenriver. The trip back up the river was quite hard, it being necessary to buck the mush ice that was on the river at that time. (R. 4205–4206.) That was a very hard trip; they hit everything coming back, because they were cutting toward the ice. (R. 4206–4207.)

Between that time and 1905 he made other hunting trips on the river in the same type of boat and experienced the same troubles as spoken of in the other trips.

In 1901 he went down to the head of the cataracts with a survey party for the purpose of surveying some bottoms for a health resort or sanitarium. (R. 4207–4208.) On the trip they had two boats, surveyors' instruments, food, and bedding for camps. The boats were just ordinary rowboats, sixteen feet long and two and a half or three feet wide. They were different boats, but the same type as the others used by him before. He can't recall the month the trip was made in, but the water was in the low stage; it might have been July. On this trip he had practically the same experiences he had on the other trips described. (R. 4208–4209.)

He was engineer on the *Undine* when it made its first trip on the river. It was equipped with a regular stern-wheel engine, a paddle wheel, and burned

coal. (R. 4210.) There were seven or eight or more people in the party on the trip.

About half way from Greenriver to the mouth of the San Rafael they struck a rock or boulder in the river and broke a hole through the planking in the bottom. The boat began to leak badly and it was necessary to beach it and patch it up. The draft of the boat was somewhere in the neighborhood of twelve or fourteen inches, loaded. (R. 4210-4211.) After patching the boat they went ahead and had the usual luck all the way. They hit many sand bars all the way down. The boat was got off the sand bars by the use of snatch blocks and lines. When the blocks and lines were used it was necessary to send a man ashore to anchor the lines. In other places they would get out of the boat and push it off with levers. (R. 4212.)

Labyrinth Canyon is a sand-bar canyon, there being no gravel there, and the water is very shallow during the low water. (R. 4212.) They were used to navigating through there so could pick their channel part of the time, keep the deepest water; other places it is impossible to do that; they simply had to work their boats over the shallow places. (R. 4212-4213.)

The bottom of the boat was practically flat and the pilot was a man named Calkey.

He can not recall how many days we used; sometimes we tied up a long while, several hours, on a bar; other days we would make good headway, cover quite a distance, some days a very few miles.

It is one hundred and twenty miles from Green-river to the forks of the river, and it is pretty hard to remember how many days they used to take going down there. (R. 4213.)

Stillwater Canyon is practically the same as Labyrinth Canyon. They had frequent groundings in both canyons. (R. 4213.)

They started out with about a ton of coal, but it did not last long and they used wood after that. They did not carry more coal because they did not want to be loaded too deep. As he recalls, the engine was a twenty-two horsepower, two-cylinder engine (R. 4213-4214), with two propellers. (R. 4222.)

The purpose of that trip was that Mr. Frank Summerall, from Denver, was trying to establish a sort of health resort, sanatorium, down at the head of Cataract Canyon, and he wanted to put this boat on in order to carry the people in and out to that sanatorium. (R. 4214.)

The destination of the trip was to have been the head of Cataract Canyon. In going down they did not have any difficulty with the current of the river except at times they would strike sand bars, then the current would bother quite a bit, because it would turn the boat around sideways. That happened very quick. (R. 4214.)

In going down if the water looked very shallow soundings were made very often with a stick; sometimes a man would be sent out with a rowboat where the water looked very doubtful, to hunt the channel

before they would try it. When they got down to the head of the cataracts they camped there several days and explored around and returned back up to the junction. (R. 4215.) They then went up the Colorado or Grand River to Moab. About three miles up from the junction just before entering the gorge they struck a sand bar. The water is a little swift there and they made slow headway. From there on up to Moab they struck some few sand bars, but they did not give much trouble because they would strike them on the low side. (R. 4214–4216.) He means by that the sand bars are always built downstream, the water carries them down, then they have a shoulder on the downstream end; if you hit them when you are going against the current, you hit that shoulder, you can back right away from it. If you hit them on the upstream side, the water carries you right on the slope. (R. 4216–4217.)

After reaching Moab the owner of the boat went back to Denver and the rest of the crew back to Greenriver.

He supposes the purpose of the Moab trip was to interest people in the resort at the head of Cataract Canyon. He had nothing more to do with the *Undine* and has never seen it since he got off at Moab. As far as he knows, it never went back to Greenriver. (R. 4217.)

He recalls a boat named the *City of Moab* and was one of the pilots on its first trip. On the first trip of the *City of Moab* they went from Moab down

to its junction with the Green River and up the Grand [Colorado] River about three miles from the junction. Between Greenriver and the mouth of the San Rafael the trip was a very hard trip because the boat was just a little too unwieldy and had too much draft, which drew in the neighborhood of two feet at the stern. He could not say how many times they grounded in that distance but could recall three or four times they were grounded very bad. (R. 4217–4219.)

The boat was equipped with a capstan to assist in getting the boat off sand bars and shallows and rocks. The capstan was used either by passing a line to shore, when it could be reached, or anchoring the line out in the stream. (R. 4219.)

He does not recall having to use the capstan in Labyrinth Canyon. They encountered a lot of trouble with sand bars in Labyrinth Canyon but freed the boat from them by levers. (R. 4219–4220.) At times they would have to dig and try to catch the water to cut the bars out on the shallow parts; the boat would drift up on the slopes and kill the water. They would dig a little bit, get out and dig a little way under the upper side, get the current cutting under it so they could turn her around; they used the ropes to shore there to pull them around. The levers he speaks of are just small poles, trees, three or four inches in diameter, not too big to handle. (R. 4220.)

The same trouble was encountered in Stillwater Canyon and there were sand bars all the way through both canyons.

As he recalls, they went down to the head of the cataracts on this trip with the *City of Moab*. (R. 4220.)

On the trip up the Grand [Colorado] River they did not get past the slide. They turned around because they could not get up the Grand [Colorado] River and went back to Greenriver [Utah]. On the trip back up to Greenriver they did not have so much work as they had coming down because they did not get hung up so tight on the bars. They were easy to get off of because they could back away from them. He does not recall exactly, but he thinks it took six or seven days to go back.

On the trip back they stopped at Halverson's Ranch, a point about seven miles below Greenriver, because they could not get over the shallow water above the ranch. (R. 4221–4222.) At Halverson's Ranch the *City of Moab* was remodeled and equipped with steam power, a paddle wheel, and renamed the *Cliff Dweller*. At first it had a two-cylinder gas motor with twin propellers.

He did not make the trip down to Valentine's Bottom on the *Cliff Dweller* but he made the trip from Halverson's Ranch up to Greenriver on it before it started down. (R. 4222.)

On the trip up to Greenriver from Halverson's Ranch they had trouble in a couple of places, but

should not have had because there was plenty of good water at that time.

He made a trip down the river to Valentine's Bottom in Captain Yokey's boat, called the *Black Eagle*. Before they reached there they blew out some water tubes in the boiler and had quite a bit of other trouble. The draft of the boat was too deep and the power insufficient. The boat had a draft of about twelve inches with a very light load consisting of a little wood, bedding, and camp equipment. To his knowledge the *Black Eagle* was never brought back to Greenriver. (R. 4223–4224.)

Another boat they had on the river was known as Oppenheimer's boat. This boat was twenty-seven feet long, six and a half feet abeam, and was equipped with a fourteen-horsepower gas engine, stern paddle wheel, and drew about eight inches of water. It had no name going downstream but coming back it was named the *Paddy Ross*, in honor of his wife, Mrs. Ross.

On the trip down they went as far as the head of the cataracts. They were hung up on sand bars, but the boat was light and easy to handle. On the trip down there were four men besides the women, and three men on the return trip, Mr. Woodruff, who owned some bottom lands about sixty miles below Greenriver, not having returned on the up trip. (R. 4225.)

Supplies for the winter for Mr. Woodruff and his sister, who stopped at his place down the river, were taken in on this trip. (R. 4226.)

On the trip with the *Paddy Ross* they struck the usual amount of sand bars on the way back, and worked through. (R. 4226.)

He made a trip on the *Wilmont*, when it was first built, from Wolverton's Ranch at Riverside to Greenriver [Utah]. The *Wilmont* was a round-bottom boat about twenty-six or twenty-seven feet long with a six-foot beam. He does not know what became of the boat called the *Paddy Ross*. The last time he saw it, it was tied up at Moore's Ranch, two miles below the Greenriver railroad bridge. That, he believes, was in 1915. (R. 4226–4227.)

When the *Wilmont* was first built it had a four-horsepower gas engine. From Wolverton's Ranch up to Greenriver they had considerable trouble with the *Wilmont*, having to help it over the riffles and to get out and wade and pull it. That happened at practically all of the riffles going up. After the boat reached Greenriver [Utah] he does not recall whether or not it went back down with Mr. Wolverton and he does not know where the *Wilmont* is now. He has not been in Greenriver, Utah, since 1916. (R. 4227–4228.)

He built the awning on the top, made the pilot wheel, and rigged the rudders up for the *Marguerite*, but he does not remember whether or not he installed the engine. He made the first trip from Wimmer's Ranch up the river on the *Marguerite*. On the first trip they could not get all the way up; they only got about half way up to Greenriver, Utah, when they

broke the paddle-wheel shaft. It was necessary to tie up and send away for repairs. After receiving repairs the boat was taken down to his [Wimmer's] ranch and repaired. The boat was floated back to the ranch. After the boat was repaired they came back up the river; he can't remember just what trouble they had; they usually had trouble on any trip up the river in low water. (R. 4228–4230.)

He made a trip down the river in the *Marguerite* to the junction of the Green and Grand [Colorado] Rivers. The occasion of this trip was to tow the catamaran, but it is agreed that his testimony concerning this trip and the incidents attendant hereto, would be the same that has already been testified to by others. (R. 4230.)

In October, 1915, he made a trip with Dr. Middleton, Mr. Baldwin, and Mr. Gregory, and a couple of others, whose names he does not remember, on Tom Wimmer's boat, the *Marguerite*. (R. 4231.) Had the usual fair trip, hit and miss. Bumped along on the shallow places; sailed—good, clear sailing between the sand bars. Had good trip coming back, that is, as good as they ever expected; got wet once in a while shoving off, but all for fun. (R. 4231.) On this trip they went down to Cataract Bottom.

With all of the experience that he has had on the Green River, he has not arrived at a point where he can pick the deepest water with accuracy. Sometimes he can do that, other times it is impossible, nobody can pick it, because at certain stages of the

water, different heights of the sand bars, a man that is accustomed to sand bars on the river can distinguish the line of a sand bar under water, although it may be six, eight, ten, or twelve inches under the water; always a little break in the water on the surface; a person wouldn't notice that unless they were experienced. (R. 4232.)

It is easier to find the channel very late in the season, in October or November, when the river is at the very lowest and more confined. (R. 4232.)

In the trips which he has made on the river he has noticed the channel is never in the same place. That is, not two weeks in succession, or two days in succession sometimes, the channel is not in the same place; may go another time, a year later, you will find the channel back where you had seen it the year previously. (R. 4233.)

It is possible to see the channel change while you are watching it, even a few minutes, when the bars are cutting. This happens as the water is reaching its lowest level, receding, when it has dropped off the top of the high sand bars, and working under the edges of them. (R. 4233.) You can see the channel changing. They think they know where to go; chances are they don't know the depth of the water they pick for the channel then; they can't see far enough ahead at one time; they may get into pockets. (R. 4233-4234.)

The river has several channels or braided channels, generally between the big bends, where there is

straight water between one curve and another. (R. 4234.)

In all of his experience he has never been able to arrive at a point where he could pick the deepest channel in one of braided channel stiuations. (R. 4234–4235.)

Cross-Examination (R. Vol. 24, pp. 4235–4264):

The trip he made in 1915 was a pleasure trip for himself as well as the others, although he was paid for making the trip. It was all done in fun even when they hit sand bars. (R. 4235.)

He began going on the Green River in 1889.

The trips he has testified to, as near as he can recall, are all the trips he made with the larger boats, but he has taken many trips besides those with smaller boats, possibly with some other power boats.

Most of his trips with the larger boats were under employment, but not so much with the smaller boats, they being for pleasure. All but two of his trips on the larger boats were for compensation. (R. 4235–4236.)

A very little hauling was done by him on the river in the rowboats for compensation. The trip made with Mr. Bullock was for compensation, while the trip made for a man [named Woodruff] and his daughter was not for compensation, it was a pleasure trip. There were some prospects on the East side of the river for several years. He took supplies down the river to them, to the people there, and he thinks it must have been in 1893. (R. 4237–4238.)

He can't say they made quite a little money out of river navigation in rowboats or non-power boats; it was very little money he made out of hauling anything on Green River in boats. Really weren't hauling anything in the big boats. Tried to get somewhere with the boats, and carrying enough provisions on to get down and back, but wasn't hauling anything anywhere. (R. 4238.)

The only party taken out by him on a hauling and exploration expedition, for compensation, was in 1915, when he made the trip with Dr. Middleton and others. (R. 4238–4239.)

As he remembers he was compensated somewhat for taking the Valentines back from Valentine's Bottom. His sister was with him on this trip, and notwithstanding his knowledge of the difficulties in going up and down the river, he took her along. (R. 4239–4240.)

He knew he was going to bring quite a party back with him, and notwithstanding his knowledge of the difficulties, he took his sister along.

He has done very little prospecting and from 1896 to 1916 he worked broken time as a hostler's helper and machinist for the Denver and Rio Grande Western railroad. He has worked on the Green River as a carpenter in putting up pumping and irrigation plants, building boats and water wheels and navigating on the Green River. He built quite a few rowboats and helped with the construction of larger boats; both the rowboats and power boats were for

other people and were to be used on the Green River. (R. 4240–4241.)

When he went on his first hunting trip in 1899 he got a deer but did not bring it back, as they ate it all up. He had no wife at that time and did not bring any back to his prospective wife.

On the hunting trips that he has been on very few deer ever got back to Greenriver, as they ate them up before they got back.

He has never done any trapping and he believes he just took Bullock down once to his property. (R. 4241–4242.) On this trip he also took down Mr. Lee Valentine, who was one of the workmen. He did not exactly take him down as they were both going down to work, but he got paid for this trip.

He was supposed to be paid for his trip on the *Undine* but never received it. He never saw the *Undine* back at Greenriver. It was tied at the bank at Moab the last time he saw it. (R. 4243.)

The *Undine* was from forty-six to fifty feet long and eight feet wide. It had no compartments except the pilot house.

They were two and a half or three days going from the head of the cataracts up to Moab on the *Undine* and were a longer time than that going from Greenriver [Utah], down to the head of the cataracts. (R. 4244.)

He does not remember the *Navajo* or the *Colorado* or any other power boats, owned by Mr. Wolverton, except the *Wilmont*, the name of which may have been changed several times, when it was remodeled.

Familiarity with the Green River and with the Grand [Colorado] River, the old Grand [Colorado] River from Moab to the junction, is of value to one who is going on the river, because you get a kind of system for judging the river, gauging the channel, the distance to sand bars, the depth of the water, the width of channels; the eye is trained to observe these things. It helps like experience in anything else. (R. 4245.) You get a system, you get a rule for laying out your channel, for picking out your channel.

You learn things from that experience that enable you to avoid difficulties in navigation; the more experience you have on either one of those rivers, the better and more recent knowledge you have of either, the more readily you will be able to navigate, and the fewer difficulties you will have. (R. 4246.)

The high spring water cleaned the channel out in places and built tremendous big bars in other places at the same time. The channel of the Green and Colorado Rivers is not left in substantially the same place each succeeding year by the high water.

The channel is substantially the same in two succeeding years; any small obstruction after high water has come down, in the lodging of a tree or stump in the river, will alter the channel. (R. 4248.) Such things happen quite frequently and build bars that will stand through quite high water. (R. 4248.)

If he should go down the river in July of one year and not go down again until July of the next year, he would not expect to find the channel in about the

same situation. They have always expected to find those channels that way, but we don't find them that way. (R. 4248-4249.) The channel is looked for where they first went through but generally they do not find it in the same place. (R. 4249.) They will find the channel changed in the straight stretches of the river; don't seem to be any obstruction of sand bars—find it changed from one side entirely to the other side of the river in different years. This year they suppose the channel is on one side, be pretty straight through on the straight stretches of the river; next year they will possibly find it the reverse, on the other side of the river. Suppose you go down the river, make a round trip from Greenriver to the junction this year, generally speaking that channel as you find it on that trip will be the same all this year.

You don't understand how that river acts; that sand is constantly cutting, even when the water is going down to its very lowest stage—even then it is cutting the high bars, the sand is changing; then as it cuts it changes the channel.

The fact that he might have been going up and down that river during the months of June, July, August, and September would not help him at all if you had to go down in October (R. 4250), although they look in those places for a channel where they have found it before; it is natural they would look where they had seen the last channel. They would expect to find it there; whether it changed or not,

they would look for it there first; they wouldn't look to the opposite place. He would use his experience and pick out the channel.

The SPECIAL MASTER. This witness has had very large experience on the river. I think his testimony ought to be of considerable assistance. I would like to go back to the question I asked. I am not entirely certain that I understand what the witness means.

Will you read back, Mr. Reporter?

(Thereupon the reporter read the preceding question and answer, as follows:)

"Q. Supposing you go down the river in July of one year and do not go down again, we will say, until July of the next year, would you or would you not expect to find the channel about in the same situation? (R. 4251.)

"A. We have always expected to find those channels that way, but we don't find them that way."

By the SPECIAL MASTER:

Q. I am not trying to confuse you, I am trying to get whatever knowledge I can of what you mean. I don't understand that answer. Perhaps you can explain it to me, Mr. Witness. I don't understand why you should expect to find them unless you had generally found them that way in the past.

A. I guess what I mean is, if we had seen the channel there before, we would expect to look for that channel there again, but we don't find it there, maybe. That would be the place we would look for the channel.

Q. What I don't understand is why you should expect to find it there unless it had been generally there in the past. I may be stupid, but I don't really see.

A. That is where we last seen it, as I say.

Q. You would expect to find it where you last saw it?

A. Where we last saw it.

Mr. BLACKMAR. I think the word "expect" means more "hope."

The SPECIAL MASTER. I don't know whether it does or not.

The WITNESS. We hope to find it. (R. 4252.)

The SPECIAL MASTER. The witness didn't say so. Personally, I don't think he does, either. I think the witness' last answer makes it clearer to my mind than it was before, that he would look for it at the place he last saw it, he would expect to find it in the place he last saw it. (R. 4249–4253.)

In a long straight stretch of river the channel is generally broken and changes from one side to the other with many little streams. (R. 4253.)

Q. Where there is not any braided channel but this one stream of water, say it is confined between walls so it can not get out and spread and make this shallow condition you have told us about, where do you usually find the deep part of the river?

A. There is no particular system to that; sometimes it is along the bank, possibly in the middle, maybe on the other bank. (R. 4253.)

Generally speaking, the channel is on the outside of a curve if the curve is not too long. (R. 4253.) If the curve is long the channel is sometimes on the inside. This condition happens on any curve that is more than a quarter or half a circle in length and a man who has knowledge of the river understands that characteristic. On the short curve the channel would be on the outside of the curve at any time of the year and most every year. (R. 4254.) If the river is narrow between the banks he does not have any trouble with boats of draft he has seen used again on the Green River.

Where he encounters the difficulty with the channel is where the stream is not confined and can spread out and probably breaks up and becomes a braided channel. In that situation, if a man is not familiar with the stream, if he has not been going up and down it recently so as to know just the proper ribbon of the stream to take he may get fooled going down stream. (R. 4255.) He may start down one part of the stream that seems to carry the most water there at the beginning. He may go down there for two or three hundred yards, and then there will be some impediment like the tree that you have mentioned, or any other thing, that will cause some of that water to flow over a shallow bar and connect with maybe the middle channel, which was a good deal smaller where he started to come down. So he will get fooled, and may take the wrong channel going down. (R. 4255-4256.)

Going up stream one can see the channel better and if he has been up and down recently he is in still better condition because of his experience. (R. 4256.)

Q. When you take an initial trip down and come to a place in the river such as I have just described, get down two or three hundred yards before the part of the stream your boat is in starts to go over a shallow bar into one other section of the stream, you are confronted with the problem whether you will take your boat clear back up stream and start down in the right channel, or whether you will drag it over the sand bar, aren't you?.

A. In this case you are talking of, that other channel where your water is crossing over into it, you can't get into the upper end of that channel.

Q. How do you know you can't get into the upper end of that channel we have been talking about?

A. Because you wouldn't have taken it; you pick out one that looks like your deepest water when you start down. You take what looks like your deepest water but maybe it is not. It is when you first start in, although you can not always tell.

You can get caught in a place like that you are describing very easily; the old, experienced hand will get caught like that right along. He doesn't know which is the right channel. (R. 4257.) He will just know by hunting it out; he has got to hunt out a channel. There is not always a channel there to find.

Many a time he has that condition—been up against that condition. He has had one channel, and one channel will divide up in so many small ones you can't pass through either one of them. That is on the Green. He has seen that condition on the Green River in Stillwater and Labyrinth canyons, all of the sand-bar country. (R. 4258). Then you have to pick out the best channel, and work our boats across it. By that he means get into it; the water helps them cut the boat loose and lug it along and pull it through. (R. 4259.)

He saw such a condition the next year as he was on the *Undine*. He does not recall whether such a condition continued when he was on the *Wilmont*, but has seen it when he was on the *Marguerite* in Stillwater Canyon. Mr. T. G. Wimmer was with him on the trip. (R. 4259.) Going down they usually let the boat cut its way through and were not boxed quite so bad coming back. (R. 4260.) They can cut loose and prospect all they want coming up. They can select the right channel, but they don't. (R. 4260.)

There have been none of the trips testified to by him except the one stated, with the *City of Moab*, on which he did not succeed in getting to where he intended going, because he always picked the time when he could get through. To his recollection the only trip that did not reach its destination was the one taken on the *City of Moab*.

On the trip up the Green River with the Valentine family, after unloading the crew and baggage at

Wimmer's Ranch, he took the boat on up to Green-river. The others went up by team and wagon because the method was much easier and quicker. (R. 4260–4262.)

The braided channel condition encountered in going down stream existed usually in August and September.

He can't recall having taken trips in any months other than those testified to and does not remember any high water trips in the spring. (R. 4262.) He has taken some trips in the late spring before high water, these trips being in March and April.

He remembers towing some lumber down to Wimmer's Ranch during a slight rise in the river, for the purpose of building a water wheel at the ranch Wimmer owned. This was done for Mr. Wynn Thompson and he was compensated. (R. 4263.) There were not a good many other such instances in his experience. (R. 4264.)

Redirect-Examination (R. Vol. 24, pp. 4264–4268):

On his first trip made in connection with the sanitarium he was accompanied by a young man named Humphreys, an older man from Denver and a boy named McKee. The trip was made at the instance of Mr. Summerall of Denver, who he, Ross, had never met. (R. 4264.)

Upon arriving at the head of the cataracts a survey was made for the purpose of outlining the land, determining the acreage, etc., in order that capital

might be gotten to finance the project. Survey for building sites was not made at that time. The survey was made with an instrument and chain. He knows of no mineral springs in the cataract bottom. (R. 4265.)

It was his understanding that the *Undine* was to be used to haul patrons to and from the sanitarium from Greenriver and Moab, Utah. He understands that Summerall was the owner of the *Undine* and believes it was constructed in Rock Island, Illinois.

In the operation of boats on the river he believes his experience assisted him in locating the deep water. (R. 4266.) The signs he looks for, that indicate deep water are these: There is a system of bars they always have to work over; it is pretty hard to explain it; you can only gain that through practice, like you read the water. Lines of these bars, working around you can form a kind of idea where you might pick—from these lines, where the deep water would be over those bars. The water comes in from different directions. You can almost trace the volume of water, where the water would accumulate and become the deepest. It is pretty hard to explain it. You can work it out for your own satisfaction, but hard to give the idea to somebody else. (R. 4267.) When the wind is blowing deep water can easily be found by the waves and it is easier to read the channel going up stream than going down. (R. 4267.) You can get closer to your plot, your reading—section of the reading; going down, maybe you commence to ground before you can see the nature of the bar you are grounding

on. Coming up, you approach it from the downstream side, you hit the shoulder of the bar first, most always; not every time, as a rule.

Of course you can check the headway of your boat quicker going upstream than going downstream. (R. 4267–4268.)

Recross-Examination. (R. Vol. 24, pp. 4268–4269):

He had never seen the pilot, Mr. Anderson, before the trip was made; in so far as he knows Anderson had never been on the Green River before. There are no warm springs or mineral springs at the head of the cataracts. (R. 4268.)

He knows of some mineral springs close to Greenriver and a few mineral seeps along the river.

He first knew he would become a witness for the Government about a month ago but did not know positively he would be a witness. He was not in communication with the Government three or four months ago, but it may have been five or six weeks ago. (R. 4269.)

Further Examination (R. Vol. 24, p. 4270):

They look for the channel in the same place going downstream as when coming upstream. But, of course, their experience tells them it is not always there. (R. 4270.)

ELLA ROSS

For Complainant

(Record Vol. 24, pp. 4271–4279)

Ella Ross, whose maiden name was Valentine, was the wife of Joseph A. Ross. She had experience on

the Green River first in 1892 when she went from Greenriver, Utah, to Valentine's Bottom. (R. 4271.)

The trip was made in two rowboats and a scow or barge. The scow was operated by two sweeps.

She recalls their party encountered difficulties in getting down to Valentine's Bottom. They started above the bridge, above Greenriver bridge, about a mile above Greenriver bridge, and we commenced to hit bars at the wash, Saleratus wash, it is the wash below Greenriver bridge. The rowboats hit them, and the barge hit the bars. (R. 4272.) The men who were on the barge would release the boats sometimes by prying them off the bars by the oars or sweeps, and sometimes by getting out in the water and pushing them off. (R. 4272.)

From the mouth of the San Rafael down to Valentine's Bottom difficulty was encountered principally from sand bars and in some places it would be difficult to get the boats free. This happened frequently. She does not remember exactly how many times a day, three or four times maybe. She believes it took probably five or six days to go from Greenriver down to Valentine's Bottom, the trip being made in September, 1892. (R. 4273–4274.)

The family lived at Valentine's Bottom one year and came out in September, 1893. Household supplies were obtained from Greenriver [Utah] while they were there. (R. 4274.) Her brother used to come up in a light rowboat, that is, a medium light, and sometimes he would generally come to the

Wheeler ranch; the Wimmer ranch now, and then have the Wheeler boys—they were cattlemen—go to Greenriver and bring the stuff down, or he might send word for them to bring it down, and have it ready for him; very few trips he made from the Wimmer ranch to Greenriver in a boat. (R. 4274.)

She made one trip while she was living at Valentine's Bottom; in a rowboat with her brother up to Greenriver. She made two trips in 1894 and she believes a trip in 1896, one of the trips being on the *Paddy Ross*. One of the trips was from Greenriver, Utah, to the mouth of the river and the other from Wimmer's Ranch to Turk's Point, a little below Valentine's Bottom. The trip she made down to the mouth of the river was on the *Paddy Ross* and she believes in 1896. Most of the trips she made down were with her husband. After she came away from Valentine's Bottom she lived there most of the time since 1915. (R. 4274–4275.)

She heard the testimony of her husband and to her recollection the conditions were substantially as testified to by him. During the time she lived at Greenriver, Utah, she never knew of boats being engaged in transporting freight or passengers on the river.

Cross-Examination (R. Vol. 24, pp. 4276–4277):

A portion of the river over which she piloted the *Paddy Ross* was a short stretch below Wimmer's Ranch. She piloted a distance she would judge of about thirty miles. She had never before piloted a

boat on that river and had never piloted a motor boat. (R. 4276–4277.)

Redirect Examination (R. Vol. 24, pp. 4277–4279):

She was on the *Cliff Dweller* on one of its trips getting off at Little Valley, where the boat was remodeled, a distance of about seven miles below Greenriver [Utah]. They went down in a light row boat and then got on the *Cliff Dweller*. (R. 4277–4278.) They brought the *Cliff Dweller* up in rather high water; she forgets just what time of year it was; the water was very swift; at one time when we hadn't gone very far, she does not remember just how far, the boat was driven against the cliff, and we very near upset; she believes Mr. Anderson was piloting the boat at the time. (R. 4278.)

GEORGE G. BYWATER

For Complainant

(Record, Vol. 25, pp. 4282–4284)

It is admitted that if George G. Bywater were called as a witness he would testify that he is a mining engineer, United States General Land Office, that he has examined the records in Emery, Grand, San Juan, Wayne, and Kane, and Garfield counties, in the State of Utah, and that the county records of those counties disclose that commencing with the year 1885, down to the present date there have been numerous placer locations in the Green, Colorado, and San Juan Rivers, the locators claiming to make said location in

pursuance of the mining laws of the United States. (R. 4282.)

> The SPECIAL MASTER. Well, I have been considering this question since it was informally discussed at the close of yesterday's session, and I am clear that the fact that various parties may have located claims on these rivers has no relevancy to the question of the ownership of the bed of the river, except to this extent, and I think that the evidence is admissable under very narrow limitations, as the question of navigability depends not only on the physical use of the river, but on its potential or actual use for commerce in a useful way. (R. 4283.)

CHRIS HALVERSON

For Complainant

(Record, Vol. 25, pp. 4285–4291)

He has resided in the vicinity of Greenriver, Utah, for about forty years, and by occupation is a farmer and stock raiser. (R. 4285.)

He helped operate the ferry at Greenriver during the high stage of water off and on for three or four years, starting in the summer of 1889 or 1890. Outside of this, he has never operated any boats on the Green River. (R. 4285–4286.)

During the time that he was in and about Greenriver and at the ferry he does not know any case where any of the merchants or other business men in Greenriver received any merchandise by way of the river. He was not taking any interest in the river traffic that was going on there; he had other business.

He does not know of anybody that got any merchandise from the river for any commercial business.

From time to time he has driven stock across the river. Up and down the river there for about forty miles, wherever there was a shallow place, riffles, they called them, there above the mouth of the San Rafael clear down the canyon about forty miles. (R. 4286–4287.) He has crossed the Green River with stock from below the mouth of the San Rafael up to where the river comes out of the canyon in the book cliffs, from about the middle of August until December. In the winter there was ice and he would sometimes cross on the ice at Little valley by his brother's place and at the mouth of the San Rafael. (R. 4287–4288.) He has crossed the river with cattle, but not with sheep, and he would sometimes have to swim them, in high water but not in low water. There were frequent times when he could cross on foot without swimming them. He has crossed them without swimming all along the forty-mile stretch of the river on the riffles at several different places. (R. 4288.)

Cross-Examination (R. Vol. 25, pp. 4289-4291):

In the stretch of the river that he referred to in his direct examination which he believes extends from a mile or two below the mouth of the San Rafael some forty miles up the river, he has crossed sometimes at a ford a mile or two below the mouth of the San Rafael. He crossed at this place in 1891 or 1892 the first time. After that he crossed further

up the river, and he believes that it was in 1891 or 1892, and that it was the first time he crossed at the place below the San Rafael. Other times he has crossed at different places further up. (R. 4289–4290.) In making the crossing he didn't have to guide their course very much as the cattle seemed to understand the riffle themselves—follow across with the water where it was shallow. He would also have to guide them to a certain extent so they wouldn't hit the deep water, and they did not swim any part of the way. (R. 4290.) Kept them in shallowest place. (R. 4290–4291.)

Redirect Examination (R. Vol. 25, p. 4291):

He would cross where the bed of the river was hard. (R. 4291.)

Further Examination (R. Vol. 25, p. 4291):

The Halverson ranch belonged to his brother, Harry Halverson. (R. 4291.)

K. D. WILLIAMS

For Defendant

(Record, Vol. 25, pp. 4327–4359)

He has resided at Bluff, Utah, for 2 years, and is engaged in merchandising business.

Worked with a survey party on lands adjacent to the San Juan River in 1924. (R. 4327.)

Supplies were received by truck from Kayenta, Arizona, to the Moonlight Trading Post, which is nearer than Bluff. (R. 4328.)

It would have been impracticable to have supplied the party by boat because of a deep precipitous canyon. Supplies would have to be carried back from rim eighteen or twenty miles. (R. 4329–4330.)

The river is accessible in a few places from Clay Hill Crossing down to where he was working. Where the rim was accessible to the river below Clay Hill, they used one boat for carrying supplies along the river, wherever walls of river made it practical, from one point to another. (R. 4330–4331.)

He was with the party from September, 1924, until May, 1925; waded the river in a number of places and never saw any point that was less than waist deep in the channel. Did not have any difficulty with sand bars when carrying supplies in the boat. (R. 4332–4333.)

Used boats at Nokai in crossing men and supplies, and traversing the river up and down for three or four miles. (R. 4333.) At Piute Mesa, used boat in crossing men and supplies and in carrying supplies upstream for three or four miles. (R. 4333.)

He was again on and adjacent to the San Juan River from December, 1925, until May, 1926. In very few places it was practicable to use the boat. The boat used was a metal boat. (R. 4334–35.) It was 12 or 14 feet long, 3 or 4 feet beam, sides 1½ feet high, as he remembers.

Did not go to the mouth of the San Juan, but has seen it from the rim and was on it at various places from the mouth up to Bluff.

Was on the Colorado River with motor boats part of 1926 and 1927, from Moab to a point about twelve miles above the junction with the Green. He has never been on the Green river. (R. 4336–37.)

Any time of year he has seen the river he believes a motor boat could be run up and down, but has never been on the San Juan in the summer time. (R. 4337–40.)

While in survey work on the Colorado used a row-boat and small outboard motor boats; one hired from the Moab Garage. (R. 4340–41.)

Supplies were brought between the places of starting and Lockhart Canyon, by boat from Moab. (R. 4342–4343.)

He was with a party on Colorado River from May until December, 1927, commencing at a point a mile and a half below Moab and extending to about six miles below the mouth of Indian Creek. (R. 4343.) Motor boats were used in this work.

Never encountered any difficulties with the small boats in daily use when at work. Has seen the large boat of the Moab Garage stuck on a sand bar about four hours, one day, and has seen the large boat stuck about eight or ten times. Small boat never encountered any trouble that held it up for

more than a minute. He did not get out and push the small boats off sand bars. (R. 4345–4346.)

On his first expedition on the Colorado River he has seen five or six boats plying the River, both up and down stream. The next year he also saw other boats than those used by the party and the Moab Garage, going up and down.

Did not observe boats in any great difficulties by way of sand bars or otherwise. (R. 4347.)

Cross-examination (R. Vol. 25, pp. 4348–4358):

He thinks a rapid is where the water has a two-foot fall in fifty feet. (R. 4348.) He did not see any such rapids on the San Juan, but did see sand waves, rapid water, and rocks in the river bed; a motor boat could be brought through there. (R. 4349.)

There were places where he could not row a rowboat up but believes a motor boat could go up. (R. 4350.)

He has never operated motor boats only on Colorado River. The San Juan River is swifter than the Colorado. Has never had his boat hung up on a sand bar on the San Juan, but did run on to sand bars, and had no trouble to back around them and find a place out. (R. 4350.) Has helped bring the boat upstream. (R. 4351.)

Where convenient to get into an eddy, he would row upstream, but in the channel it had to be towed.

While on Colorado River in 1926, the party went up the river in a boat; does not remember how they went out in 1927, and does not remember where he went out overland with a pack train. (R. 4352.) Went overland from Bluff to Moab. (R. 4353.)

He saw one row boat going upstream on the Colorado, and saw two row boats rowed upstream. (R. 4354–4355.)

If stopped getting out of the channel, on sand bars, they had no trouble getting off. (R. 4355.)

He believes the bed of the Colorado on the section he was on was quite permanent. He never saw any changes. (R. 4355–4356.)

Saw changes in the bed on the San Juan and it shifted around but not from day to day. The San Juan changes every time the water comes up or goes down in a great flood, but there are places where it does not change. One place it does not change is just below mouth of Nokai Canyon and at Zahn's Camp. He never saw the current of the river change there. (R. 4356–4357.)

Has observed a change at the mouth of Nokai and at the mouth of Copper Canyon, but not at the mouth of Piute Canyon. He has seen it change at Indian Farms. Did not find the same condition on the Colorado River, as that was permanent. (R. 4357–4358.)

Further Examination (R. Vol. 25, pp. 4358–4359):

His work on the San Juan River itself was from Clay Hill Crossing down about six miles from the mouth, but not all that distance in a boat. Has only been in a boat about twelve miles in different places. Has been along bank and waded. (R. 4358–4359.)

WILLIAM J. NIX

For Defendant

(Record, Vol. 25, pp. 4360–4364)

He resides at Blanding, Utah, engaged in variety of businesses, but principally he is a carpenter.

He lived at Bluff between the years 1893 and 1895 when he made about five or six boats for miners during the Gold excitement. (R. 4360–4361.) Saw the boats taken by wagon down the lane to the river and saw the miners take supplies down that road. (R. 4361–4362.)

Has seen boats made by others go down the lane. The boats he made were just a crude kind of row-crude kind of rowboat. (R. 4363.)

He judges they would go down about a foot loaded. (R. 4364.)

Cross-examination (R., vol. 25, p. 4363):

The boats he built were made out of common pine lumber about one inch thick. Pulled them together

and made a kind of a bow; used oakum between cracks and nailed slats over and calked them up. A crude kind of rowboat. (R. 4363.)

Redirect examination (R., vol. 25, p. 4364):

Dimensions of boats he built, about 16 to 22 ft. long and about 3½ to 4 ft. wide. He has seen them in the water and judges that they would go down about a foot loaded. (R. 4364.)

ALBERT R. LYMAN

For Defendant

(Record, Vol. 25, pp. 4365–4371)

He has lived at Blanding since 1905 and before that he lived at Bluff. (R. 4365.) He is 49 years old, and a school teacher.

When a boy at Bluff he remembers seeing boats made and taken down the lane to the river.

Elk Ridge has some very fine timber. (R. 4366–4367.)

Quite a bit of land that could be farmed on Elk Ridge. (R. 4367.) Country around Blanding is a farming country, and at one time had been cultivated by prehistoric people. He has seen grapes, peaches, and apple trees grown on dry farm land. (R. 4368–69.)

Was the first settler on White Mesa. (R. 4369–4370–4371.)

No cross-examination. (R. 4371.)

G. W. PERKINS

For Defendant

(Record, Vol. 25, pp. 4371–4387)

He is 50 years old. (R. 4371.) He has been in the cattle business practically all of his life and resides at Blanding. (R. 4371.) Has never had occasion to use boats on the San Juan River, except to cross after cattle, but crossed the San Juan at various points and recalls one year when it went dry for about ten days to two weeks. First went into the San Juan country in 1880.

Crossed just below Bluff at Sand Island; river very wide there and does not know of any place it is more shallow. (R. 4373–4374.)

Does not remember crossing at any point where the water does not come up near a horse's belly. (R. 4375–76.)

He has a ranch at the head of Comb Wash and believes there were three or four thousand acres there similar in character. He has 160 acres and about sixty have been under actual cultivation. Grazing land on Elk Ridge down to the river, is used by cattle. There are no sheep. Some very good dry farms just north of Blanding raising wheat. (R. 4377–78, 4379.)

He has crossed river on horseback and with wagons. (R. 4385.)

The country west of Bluff as far as Clay Hill has some big canyons that run through, and large hills. (R. 4378–79.)

Some dry farms north of Blanding, but does not know how many bushels to the acre. (R. 4379–80.)

Cross-examination (R., Vol. 25, pp. 4380–4384):

There are no sheep on Elk Ridge. In crossing cattle he tries to find where gravel or cobble rock. (R. 4380–81.) The first time he crossed he knows a lot of the cattle had to swim, but he didn't say the second time just how deep it was. (R. 4384.)

Further examination (R., Vol. 25, pp. 4384–4387):

He ranged the territory south of the San Juan River, and east and west from a spring called Huckatoo to Copper Canyon. (R. 4384.)

The other times when he crossed the river when he was not with cattle he would cross on horseback and with wagons.

At Chinle he crossed mostly with wagons, as the road crossed there before a bridge was put in. The reason he happened to cross here was he took an oil rig down for some men who were drilling for oil at Huckatoo springs.

When he crossed in the boat at Moonlight he had taken a man down to work with the miners. They went down on horseback. The miners had a boat and were camped on the north side of the river. They came to the river on the south side and the miners came over in a boat and got them. (R. 4385.)

He got in one evening and left early the next morning for home.

Once he crossed just above Mexican Hat in May when he was gathering a bunch of cattle to drift them down to the Elk Mountains.

On this occasion they took off their saddles and cloths and the horses had to swim.

He doesn't recall any other time that he has crossed the river. (R. 4386–4387.)

H. C. PERKINS

For Defendant

(Record, Vol. 25, pp. 4388–4394)

He is 54 years old, is in cattle and sheep business, and resides in Blanding. (R. 4388.)

He is familiar with the San Juan country. Character of land from Hole in the Rock eastward to Elk Ridge, for first twenty miles is splendid grazing land, he would say, and as you near Elk Ridge, good farming land on the South side of San Juan back of Navajo Mountains, there is a lot of splendid agricultural land on the high mesas. (R. 4389.)

Has crossed the San Juan at various points; shallowest place on the river is at Sand Island. Recalls the time the San Juan went dry. Since that time has never seen the San Juan when it would not strike a horse up to its belly. (R. 4390.) In the summer of 1928 the river was low, and cars were taken across with a good team. (R. 4391–4392.)

Knows there is timber on Elk Ridge, and on the La Sal and Blue Mountains. (R. 4392–4393.)

Ten or twelve inches rainfall required for dry farming. Recalls he was at Piute after the flood of 1911. (R. 4393.)

Cross-examination (R., Vol. 25, p. 4393):

It is necessary to have ten or twelve inches of rainfall for dry farming.

He has been on the San Juan River from Bluff down to the mouth at different points and to his knowledge, the river isn't wider at Piute farms than at Bluff.

He doesn't recall the last time he was at Piute farms, but it was probably ten or fifteen years ago, and as he recalls it was after the flood of 1911. (R. 4393.)

Further Examination (R., Vol. 25, pp. 4394–4395):

He was born at Bluff and has crossed the river several times a year, both with cattle and on horseback. (R. 4394.)

DAN PERKINS

For Defendant

(Record, Vol. 25, p. 4395)

It was stipulated by Counsel that if Mr. Dan Perkins, who was 42 years of age, would testify, that his testimony would be substantially the same as that of Mr. G. W. Perkins. (R. 4395.)

A. S. WOODS.

For Defendant

(Record, Vol. 25, pp. 4396–4432)

He resides at Monticello, San Juan County, Utah, and his full name is Arthur Stephen Woods.

He is 53 years old and came to San Juan County when he was a boy and lived at Bluff, Utah, moving away from there about 1905.

He has been engaged in the cattle business all his life, has never been a placer miner, but recalls the years when there was a gold excitement on the San Juan River. (R. 4396–4397.)

As a boy he saw the miners on the San Juan River in their boats at different places, some going up and down stream and others stationed on the bank of the river. He recalls two instances where boats were taken and put on the river at Bluff.

He does not know how far the miners whom he saw in their own boats have gone downstream. (R. 4398.)

He has seen miners at the mouth of Comb Wash, Gable Camp, and possibly, Mexican Hat. These instances were in later years, when he was riding the range.

He has seen a boat going upstream at the mouth of Comb Wash or the Barton cabin that is an old trading post close to the mouth of Comb Wash.

There were possibly four or five men in the boat, and he doesn't know where they were going. They were towing in places and in other places, they would row. (R. 4399.)

He doesn't know any other points that he saw boats going upstream.

He recalls the time that there were carpenters and miners at Bluff, building boats, remembers seeing them, but doesn't know who did the work, nor the particular boats he saw. The boats that were made at Bluff were taken to the river directly south of town. (R. 4399–4400.)

He would take from twenty to thirty cords of wood on the raft and would use the river for six or eight miles from up stream down in to Bluff.

While he was riding the range, he has forded the San Juan River at different points; at Sand Island, a few miles west of Bluff; at the mouth of Comb Wash, below Comb Wash; and he used to ford quite a little above Bluff, a mile or so.

He has been in the river at Mexican Hat a number of times, crossing the river for cattle. He remembers one time, in particular, when he swam across the river with his horses to get them.

He has also crossed the San Juan River at the Gable Camp and at a number of other places.

He has ridden the range between the San Juan and the Colorado Rivers to the junction of the rivers and as far up the [San Juan] river as the Colorado line. (R. 4401–4002.)

He has been down the San Juan River to the mouth, has followed down the river on the south side clear to the mouth [of the San Juan] both along the sides of the river and in the hills on the river, and at various points has been right down to the river and has crossed at these points a number of times. (R. 4403.)

He has some cattle there and remembers the year the San Juan went dry for a month or six weeks but as he remembers it, after the rains came, the river went back to normal.

Aside from this dry year, the river, where he forded it would vary from two or two and a half feet to swimming water, and this was true even at the lowest stage. (R. 4404.)

There are times when the San Juan River can not be forded without swimming, but at any high water time he would have to swim his horses at any point he has ever seen, and when the real high water season is on, there is a large volume of water. (R. 4405.)

He has possibly crossed the San Juan River in most all months of the year and for a good many years he used to cross the San Juan the whole year. He has crossed in the winter time, sometimes on the

ice and sometimes he would ford it, and he believes he would be truthful in saying he has crossed every month in the year, although there might be a month or so in the high water that he didn't cross. He doesn't believe the matter of swimming a river is a difficult or unusual feat for cattlemen.

Sometimes in crossing he would hold to the saddle and go along with the horses and sometimes ride the horse and let it do the swimming. (R. 4406.)

In crossing, there are some animals that will lead off and the others will follow. He doesn't cross the river with wagons unless it can be forded and then just drives into it.

There used to be a regular ford at San Island and at the mouth of Comb Wash, on the old road to Gable Camp and he used to ford the river above Bluff at a number of places. (R. 4406–4407.)

During his experience there he has known of heavy rains and floods coming down the side canyons and down the San Juan, but these floods are not a matter of yearly occurrence. He only recalls two floods that he terms floods, and they didn't occur in the same year.

He considers a flood as where the river overflows its banks and comes up on the benches and higher ground where people were farming and above its channel. (R. 4407–4408.)

The cause of the floods in that country is from the heavy rains in the higher country, that the river drains, and not from cloudbursts.

After he left Bluff in 1903 or 1904, he went to live at Monticello has resided there ever since and is acquainted with the country between Monticello and La Sal and west of the Colorado River. It is a country that he calls Dry Valley, open sandy loam country, level for that part of the country; it is rolling, of course, but you can get at one end of the valley and can see for miles and miles through it. It isn't cut up by the big gulches and sudden precipitous places that occur farther out. (R. 4408-4409.)

He is describing the country between Monticello and La Sal and west to the Colorado. It is what he terms a winter-range country, and he has ridden through there.

The summer range for stock in this country is in the La Sal Mountains, Blue Mountains, and the Elk Ridge, winter range being in Dry Valley that lies between the La Sal and Blue Mountains and on the south and west of the Blue Mountains.

The general slope of Dry Valley is to the north. (R. 4410.) This section does not permit of dry farming being done successfully; the annual pre-

cipitation is not enough; but it is a very good winter range, and in his opinion, if water could be placed on it, the soil would be tillable and grow good crops. (R. 4411.)

The area on Elk Ridge and in the section extending to the south from there is higher land, and the precipitation is more than it is farther west or south.

In connection with his cattle, he keeps in close touch with the growing of grain and feed of various kinds in that section of the country and he is engaged in dry farming himself, and has seen others do it. (R. 4412.)

He is familiar with their land and he is sure that there would be one hundred thousand acres of tillable ground on top of Elk Ridge, but farther south than that it could not be dry farmed.

He is familiar with the country east of the Blue Mountains and from there on east to the Colorado line. (R. 4412–4413.) That section of the country is the dry-farm section and is being dry farmed. There are a few farmers there now and it is a very productive soil.

He recalls one year that he threshed three fields of wheat; one field went twenty bushels, and another went forty bushels, and still another one went forty-

six bushels, but he believes the average of these is a little more than the average of the other farmers. (R. 4414.)

The area of the dry farm land of this character extends sixteen miles from Monticello to the State Line [Colorado-Utah] and in his judgment is twenty or twenty-five miles north and south.

He doesn't believe there would be more than three or four per cent of the land farmed. He knows it would be very small.

On to the south of this area, there is tillable land which is lower than the land he has just described and he knows that it can be covered by the Dolores project. This land lies both east and west of Montezuma creek. (R. 4414–4415.)

The section of land west of Bluff that is bounded on the west by the Colorado River and on the south by the San Juan, has some deep gulches running through it and large mesas or flat country between the gulches. This is all a splendid winter range.

He has gained knowledge relative to the mineralized sections of San Juan County. (R. 4416.)

In the Blue Mountain country, he knows of what he calls the Duckett property on the West mountain that was worked for gold, and there is a tunnel or a shaft of about 80 feet, and he believes they are holding the claims by doing the Assessment, but are not doing any more mill work. He

doesn't know whether the ore is free-milling or not, but it is in a ledge.

On the east side of Blue Mountain, he knows of the Gold Queen property, and there was a mill built on the west side of the Blue Mountain, the name of which he doesn't recall. This mill is still intact, and he believes has been used in recent years. This was also a gold property. (R. 4417–4418.)

On the north side of the bluff in what he calls North Creek, the Emms boys still hold gold property, and there is a mill built on the west side of the La Sal Mountains for gold ore; he doesn't know whether it is still there or not.

There are a few prospects in the country that were never worked. There are copper properties east of the La Sal Mountains close to the Colorado line. (R. 4418.)

There is the Big Indian Copper Company located between the La Sal and Blue Mountains which has an immense deposit of copper ore, and also at Lisbon Valley farther down from the Big Indian property there is also copper, similar to the Big Indian.

In Copper Canyon, there is both copper and silver. (R. 4419.) The Canyon comes into the San Juan River, about seventy-five miles west of Bluff, and there is a copper property between

Copper Canyon and the Navajo Mountains where the copper occurs in sandstone conglomerate, and carries silver values.

Native silver has been found in the Copper Canyon country. He knows of two or three small veins of coal in San Juan County, of a vein of coal west of Monticello that he opened up that was six feet thick, of coal on Squaw Creek in the southwestern part of the county that faces up about ten feet, and other smaller veins of coal two to three feet thick.

They are working a small vein of coal east of Monticello, in which they have about four feet of coal.

He doesn't know of any work that has been done looking toward the location of these coal veins at other points in the county. (R. 4420–4421.)

Outside of the Big Indian Copper Company and the mills that were built in the Blue Mountains which never ran to amount to anything, there has never been any extensive work or money spent to develop the mineral resources. (R. 4422.)

Cross-examination (R. Vol. 25, pp. 4422–4431):

He has made a number of trips into Copper Canyon country and taken samples with the view of having the country worked. (R. 4422.)

When he went into the country he went overland and he never went down the river in a boat.

None of the properties that he has described are being worked at the present time except the Big Indian property, and he doesn't know what they are doing there.

He was in that section of the country a few weeks ago and there were men there, but he wasn't through the mine and doesn't know what they are doing.

He hasn't been down to the Mendenhall Trail since he left that country, but there were possibly two or three placer miners when he was last in there. (R. 4423.)

When he was a boy at Bluff, he used to go in swimming in the San Juan River, and also used to wade across.

He couldn't give the date of the two floods he testified to, and doesn't know whether or not they were the floods of 1894 and of 1911, but he recalls a flood about the time of 1911.

He remembers a big flood they had in Bluff when the water came up into the orchards and into the fields and the town.

He was a young man at that time working in the Gold Queen Mine in the Blue Mountains.

He remembers another time when the flood wasn't so heavy, but it came close to the edge of

town. He couldn't fix the dates of these floods. (R. 4424–4425.)

The thundershowers that occur through this section of the country do not affect the river very much, but the September rains that drain the entire country do raise the river.

At Bluff you don't see much of a rise from thundershowers. (R. 4425.)

The rains in September cause the river to rise; the rain is general over the higher country at that time. (R. 4425.)

These rises do not compare with the two big floods. (R. 4425.)

The grazing on the winter ranges is all over the country, on the upland as well as the washes.

The pie-shaped area from La Sal Mountains down to the junction of the San Juan and the Colorado Rivers is susceptible of irrigation, and would be productive if they had water to irrigate it; it is not, however, susceptible to dry farming.

If there were water practically all of it could be irrigated. Sometimes the rougher countries are the best places for winter feeding, and the stock sometimes winter better in the rough, high countries, than they do in the valleys.

The people around Monticello will feed some, but in the pie-shaped country west of the La Sal Moun-

tains, they do not, except that some of the sheepmen will feed a little grain. He doesn't believe that there is any place in the State where they have more winter feed than in Dry Valley. (R. 4426–4427.)

He drove through Dry Valley on his way to testify and went on up to Moab. He also has a few sheep in Dry Valley, has been over the range pretty well this fall, and was in Dry Valley practically all summer.

He couldn't say how many acres of grass are necessary to range a steer. (R. 4428.)

The Dry Valley country extends from a point below the confluence of the Green and the Colorado to a point above the confluence and thence east.

The section of the country west of the 110th meridian and the Colorado and San Juan Rivers is too low for dry farming, and is not susceptible for that purpose, but there is a large acreage that could be farmed if there was water for it. (R. 4429–4430.)

He thinks it would be very little, if any, coal burned at Bluff, and very little burned in Monticello. There might be a little burned in Blanding, and most of the coal that is used is brought down from above Thompson Springs or shipped from Dolores. (R. 4431.)

WILLIAM HYDE

For Defendant

(Record, Vol. 25, pp. 4432-4451)

He resides at Monticello, San Juan County, Utah, is 53 years old, and at the present time is engaged in trapping on Antelope Island, in Great Salt Lake, west of Salt Lake City. (R. 4432-4433.)

He at one time lived in Bluff, San Juan County, Utah, having gone there in about 1880, and lived there two or three years. He has seen miners start down the San Juan River from Bluff in boats. Altogether, he has seen ten or twelve boats, possibly more. (R. 4433.)

He has also had experience on the Colorado River below Moab. He can't remember the year, but it was between seven and eight years ago. He entered the river at the town of Moab with a partner. (R. 4434.)

He had two boats, one about sixteen by four, and the other about fourteen by three and a half. These were not motor boats, just small rowboats with a light draft. It was a trapping expedition, and he went down into Cataract Canyon about opposite the Henry Mountains. (R. 4435.)

He went through four or five rapids, possibly more. These were big rapids and most of the swift water was in them.

He can't tell exactly how far below the junction of the Green and the Colorado he encountered the first rapid water. He was in Cataract Canyon pos-

sibly a little over a month. He took his boats down and brought them back up the Cataracts, and on up the river to Moab. (R. 4436.)

He left Moab along the fore part of November and came back the fore part of February, taking supplies with him for the whole trip, and obtaining none after he left Moab; there was no place to buy them.

He had some trouble getting back up Cataract Canyon. (R. 4437.) Going down he led his boats along the edge of the shore and pulled it and packed it most of the way back. He got some furs on this trip, took them back with him to Moab, shipped part of them to Denver and sold part of them in Grand Junction. He had a pretty successful trapping expedition and made wages. The furs he gets are cats, foxes, coyotes, and beaver. (R. 4438.)

While he was on this trip there was a Colorado man, a trapper, passed him who came down the river from Grand Junction, Colorado. The Colorado man had some furs with him and a light rowboat. He saw Mr. Turner trapping on the river, but outside of these two boats he didn't see any other. He doesn't believe he had any trouble with the said bars, or very little. (R. 4439.)

He has run into sand bars, and if one doesn't follow the current of the river they will strike them. He has run into said bars when he wasn't watching where he was going, but when he pays attention and watches the progress of his boat he

never has trouble with sand bars either going up or coming down. (R. 4440.)

The following year he had some trapping experience on the Green River. He trapped for Beaver and he had a partner on this trip, Andy Middlemas. He believes Charlie Snell was his partner on the first trip. On this second trip he had two boats; started from the town of Greenriver, and went to the mouth of the Green and up the Colorado to Moab. (R. 4441.) He remembers he left Green River about the first of October and was gone about five months on the trip, getting into Moab in March of the following year, the trapping trip being successful. When he arrived at Moab, he shipped his beaver skins to the State, at Salt Lake City. (R. 4442.) He carried the skins in his boat as in the previous year he had carried the furs he had obtained by trapping, in his boats. He was held up on this trip about seventy-five miles below the town of Greenriver for about 30 days, because the river was frozen up and he couldn't travel, but outside of that he encountered no difficulties from sand bars or rapids or other obstructions in the river. (R. 4443.)

The year previous the [Colorado] river didn't freeze, but there was a little mush ice running. He doesn't know what happened up on the Green River. (R. 4444.) As far as he could see, there was no evidence of it being frozen in February, but on the second trip, when he was frozen in on the Green

River, he would say the ice was about 1½ or 2 inches thick. There would be a strip frozen over solid a mile or two and then a strip of open water for a quarter of a mile, and it wasn't safe to go on it and so he stayed for a month until it was safe. (R. 4445.)

Cross-examination (R., Vol. 25, pp. 4446–4451):

He didn't find the channel the second time he went up the Colorado in exactly the same place as when he went down and up the previous year, as it changes.. (R. 4446.)

He would accidently run up against a sand bar sometimes, and he has done this at different times, but would just push off and go ahead. On his first trip he would say that he was stuck on not to exceed two or three sand bars in the 65 miles from Moab down to the junction and back.

He rowed his boat up most of the way, but lots of places he pulled and towed it. He towed it through the slide. (R. 4446–4447.) He does not know where the "Slide" is, unless it is the Cataracts. (R. 4447–4448.) He recalls a place on the Colorado River where there is a slide from the bank that almost fills the channel, but he just rowed his boat through it.

On his second trip going down the Green River he doesn't know whether or not he went as far as the mouth of the San Rafael and doesn't know where the mouth of the San Rafael is, as there are

lots of canyons and washes come into the river on both sides. (R. 4448.)

There were two or three small rapids just below the town of Greenriver, but they were very small, and they didn't give him any trouble. There were no rapids within ten or fifteen miles of that place that gave him any trouble. He didn't ground at any place, and he doesn't remember getting on any sand bars from Greenriver, Utah down to the junction with the Colorado River. When he was moving camp he would keep in the current to avoid sand bars and he doesn't remember getting stuck on any. (R. 4448–4449.)

He would make his camp there, set his traps, stay three or four days or possibly a week, go out every morning and bring whatever he had caught in. In trapping with a rowboat he couldn't set a line of traps over three or four miles, because it was too hard work.

When he was on the Green he saw a row outfit about seventy-five miles below Greenriver, Utah. They had some boats, but that was the only outfit he saw. They were from Moab and he doesn't know whether he could remember their names or not. (R. 4449–4450.)

Further Examination (R. Vol. 25, pp. 4451):

Beavers build on both sides of the river as a rule, starting where the water is deep and building back. (R. 4451.)

FRANK H. KARNELL

For Defendant

(Record, Vol. 25, pp. 4452-4474)

He resides at Bluff, San Juan County, Utah, where he is Justice of the Peace, is 58 years old, and is engaged in the business of farming at the present time. (R. 4452.)

He first came into the San Juan section from Pueblo, Colorado, in 1904, and went to Mexican Hat to placer-mine. After he arrived there he went up the river looking over the bars, found a camp stove up above camp some twelve or fifteen miles, he took some logs and built a raft and took the stove down to the camp. He made this trip in the latter part of August. (R. 4453.)

He remained at this camp about four or five months, and when he arrived there he didn't have any boat of his own, but he found a bar on the opposite side of the river and decided to get a boat. He borrowed one from a farm at the mouth of Butler, about five or six miles above the head of the canyon. The boat belonged to an Indian by the name of Jim Joe, and he used the boat there five or six months. (R. 4454-4455.) He took a trip in the boat down to Soda Basin, a distance of about twenty-five miles, and used the boat in the basin and in the upper canyon, taking it up and down as he moved camp and worked the bars. He used the boat upstream as well as down, and would

sometimes move a mile or two and sometimes as much as four or five miles at a time. He would row and pole the boat upstream. (R. 4455.)

Soda Basin is near Mexican Hat, where there is a long point that runs out to the north on the east side of which is Soda Basin. It is about a mile and a half across the neck and about five or six miles around. He was placering in the basin.

When he took trips up the river he would take supplies in the boat. He returned the boat to Jim Joe in March of 1905, when the high water started and then got another boat. (R. 4456.)

He went to Bluff and bought lumber and built a boat. The boat he borrowed from Jim Joe was about sixteen feet long, four feet wide, with a draft of about seven or eight inches, and the boat he built was sixteen feet in length, seven foot beam, with a draft of probably eight or ten inches. He got the lumber and nails for his boat from Frank H. Hyde, who was running a mercantile establishment there. After he built the boat, he bought supplies and took them down in the boat to his camp. (R. 4457.) He had about a thousand pounds of supplies, and he bought them from Frank Hyde and the Co-op that was run by Kumen Jones. He built his boat right on the river bank in Bluff, he maintained his camp between Chinle Creek and Mexican Hat until March, 1906. While there, he moved the camp up and down the river as he worked. (R. 4458.) He

couldn't use anything else to transport his camp and supplies in the canyon excepting boats.

In March he decided to take a trip down the river below Mexican Hat in boats. His partner who had been with him all the time, had a boat constructed, sixteen by five feet, at Bluff. They were joined at camp by a man named Philpot, who built a boat for himself about eighteen by six or seven feet in width. (R. 4459.) The boats were loaded with their supplies and camp equipment, rockers, tools, and wheelbarrows and started down the river. The river was extremely low. Each boat was loaded with supplies and equipment and they went down as far as Mexican Hat, their first stop. Mr. Raplee had a party in there from Colorado Springs, he believes by the name of Yates and McQueen, who were testing placer bars, and they remained with them there about a week or ten days. Then when the work was completed, he continued the trip down the river, and went down to what he calls the Mendenhall gooseneck, remaining there for a short time prospecting, and then decided the easiest way to work the canyon was to go down and stop on a bar and work it out and move on to the next. When they got down to Honaker Trail he sprained his ankle and couldn't get around on the rough gravel, quit the river, left his boat and supplies with his partners and they continued on down some distance. (R. 4460.) His partners agreed to leave the boat down as far as they went, which would be

somewhere between Slick Horn Canyon and Grand Gulch and after his ankle got better, he went back to the river and found his boat down below Slick Horn Canyon in the vicinity of where his partners were expected to leave it.

The trip that he made from Bluff to the Mendenhall gooseneck with the three boats was in March and the fore part of April, before high water. (R. 4461.)

In September, 1905, he saw Calhoun and Clay at Bluff City, they having a boat that had been used for some time. They had come down from above and they went on down the river with their outfit in the boat when he was camped down below Bluff about two miles. They came to his camp and asked permission to go down the canyon and work some of his placer properties. (R. 4462.) He later saw them down the river after they got their supplies from Mr. Hyde and were moving down. They asked him to go with them. After he went down and found his boat at the agreed spot below Slick Horn Canyon, he went from there to the mouth of Grand Gulch. This was in the fall of the year, about December.

Later in 1909 he made a trip from Chinle down the river in a boat that belonged to some miner that had been working assessments for him. (R. 4463.) On this trip he had about seven or eight hundred pounds of supplies and he went down to Mexican Hat.

In addition to these boat trips he has described, he has made other boat trips on the San Juan, both up and down the river. He has traveled from close to the Honaker Trail up and down the river to the head of the San Juan Canyon, which is the mouth of Chinle. He also believes he has made a trip from Zahn's Camp up to the Gable Bar by boat.

When he was traveling upstream he would pole and row, and sometimes when he came to a riffle he would tow the boat. (R. 4463–4464.)

He would estimate that he has seen probably about twenty separate parties go down the river by boat from Bluff, and has seen about eight or ten go past his camp, that was in the upper canyon just below Chinle Wash five or six miles.

The other trips that he has made were usually along in the fall, early winter, and spring months. Placer miners don't do much work during high water, as the bars are covered up and can't be worked very successfully. (R. 4465.)

He believes the minimum depth of the channel at points he has seen below Chinle Creek would be about three feet.

In going up and down the river, he has encountered difficulties from sand bars, as when he would come out of a box [canyon] into open spaces in the river very often he would encounter a sand bar in the middle of the channel and the water would divide and unless he was careful and understood about the sand in the river he would be liable to

run his boat on the sand. When he would strike a sand bar, it would take about fifteen minutes to push the boat back in the water and go around, but this didn't happen very often. (R. 4466.)

He has never seen the time when he couldn't find a channel somewhere in the canyon.

In getting off the bars, he would have to get out of the boat very often and pull it off, but that was not how he estimated the depth of the river.

He has waded the river frequently in working the boats off, as when there were three of them together and one would run on a sand bar, the other two would stop and hunt out the channel, and one would usually wade out and find where it was. That spring the river was extremely low, as low as he has ever seen it, and it required a good deal of caution to watch out for rocks going over riffles and also for sand bars on the flat part of the river. The lowest he saw the channel when he got overboard was three feet. (R. 4467.)

In using his pole he had an opportunity to gauge depths and in going up the river, he could make better progress with a pole than he could with the oars, generally speaking. There are some rapids in the San Juan River, and to negotiate the rapids it was necessary for him to strip and act as a rudder to the boat and shoot the rapids, and in one or two places, the other men would catch the boats and hold them after he got through.

The greatest distance that there would be rapid water that he encountered would be about one hundred yards. (R. 4468.)

Cross-examination (R., Vol. 25, pp. 4469-4474):

The first time he went in to do placer mining, he went in with a team and wagon and kept the team down there all the time. He used them to pack supplies occasionally and most of the supplies were brought in overland.

When Philpot and the other man went in with him to build their boats, they went in overland, although they had a boat down there. It was faster to go up with horses. (R. 4469.)

After he sprained his ankle he went up to Bluff with horses.

He had three boats at that time but he left them on the bars and came out overland because it was the easiest way. (R. 4470.)

He does not know of anybody down there that diverted the entire flow of the river at one time, during low water, and he did not do it himself.

In the canyon the river is confined to such an extent that it was impossible for it to change its channel, but outside of the canyon, the river changes its channel once in two or three years and sometimes it may change two or three times in one season. As the water goes down or comes up, it may change from day to day, but he wouldn't say that every change in stage brings a rearrangement

of the sand bars as the rearrangement usually occurs in the high summer floods. The spring floods cut out the sand bars and carry them down, but he doesn't believe they are deposited further down. (R. 4471.) He thinks it raises the level of the river above the canyon—kind of spreads the sand out and raises the level, and when the water starts to go down, it rearranges the sand so that in one place in the river, it may be a sand bar there to-day, and it won't be there to-morrow.

Every year he has been in Bluff there are floods in the fall of the year usually, and he has seen it raise thirty feet in one night but it hasn't the same effect on the sand bars as the spring flood. (R. 4472.)

The sand is usually deposited by the fall floods and the sand remains on all the dead water. These floods rise and fall suddenly, but the spring floods rise slowly and fall slowly and the water eats the sand bars up. The result is the same, in that it brings a rearrangement of all the sand bars, so he would say that the San Juan River above the canyon has a very unstable channel, and when he says the canyon, he means above Chinle, as the canyon begins three quarters of a mile below Chinle Creek and there are no sand bars to speak of below. As far down as he has been, he hasn't found any. (R. 4473.)

All the sand bars he speaks of are above Chinle Creek, and he doesn't know where Piute farm is. (R. 4474.)

WILLIAM E. OLIVER

For Defendant.

(Record, Vol. 25, pp. 4475-4478.)

He resides in Blanding, Utah, and first came to Blanding from New Mexico in 1911.

He is a cattle man and in riding the range he has had occasion at times to come to Bluff and in the vicinity of Bluff and below. (R. 4475.)

He believes in about 1912, after he moved to Blanding from New Mexico, he saw a boat party on the San Juan River about five miles above Bluff. There were two people in the boat and they also had a barrel. He doesn't know whether or not the supplies were carried in the barrel, but supposed they were. It was about a forty-gallon barrel. (R. 4476.) He saw these men later in Bluff, but not in the boat. He saw them going from the store down to the river, and he followed them down, but he doesn't know what became of them. He only knows they went off down the river.

He has a ranch west of Bluff and had some of his cattle down there.

He saw one boat on the river below Bluff with two men in it. (R. 4477.) He saw them from the rim and the men appeared to be working the sand, panning it out. This was about two miles below John's Canyon, and was five or six years ago. (R. 4477–4478.)

JOHN L. HUNT

For Defendant

(Record, Vol. 25, pp. 4478–4486)

He resides at Bluff, Utah, and has been there since 1920. Prior to that time he lived at Fruitland, New Mexico, and before coming to Bluff he took a boat trip on the river from Fruitland, New Mexico, as far down as Copper Canyon.

There was one other man with him, and he went all the way on the river. He was trapping and the other man was placer mining. (R. 4478–4479.) The entire trip took about two months. He left Farmington on the 15th of October, 1910. (R. 4480.) After he got through trapping he went to Kayenta, Arizona, from Copper Canyon. He got a couple of burros and packed the bedding and other stuff and walked and rode. It was closer back home that way, and was easier than to go up the river with his boat. It was just a rowboat. (R. 4480.) While he was on the river in Copper Canyon, he saw three different boats, but he doesn't know how much farther down they went.

When he went to Bluff he went into the mercantile business, bought the old Co-op. that used to be run by Kumen Jones; ran this store for about five years and one time made delivery of supplies to people who were going down the San Juan River in boats. There were two in the party and they bought a few supplies and he drove them down to the river in his car. (R. 4480–4481.) He doesn't

believe the boat was over fourteen or fifteen feet long and about five feet wide. The boat he and his partner used on his trip was about fourteen feet long and four and a half feet wide.

The three parties that passed him at Copper Canyon were in small rowboats that looked like his.

The time he sold the supplies from the store to the men going down the river, he doesn't believe there was over one hundred pounds of stuff, coffee, bacon, and sugar, and the men said they were placer miners, but he doesn't know where they went.

While he lived at Bluff he did not see other boats that were made there and taken to the river. (R. 4482.) He saw two boats come in on trucks and he was told they were going to take the river at Sand Island. They passed through Bluff and he saw them, but he doesn't know where they went. There was a boy from Bluff, Hugh Hyde, who went with them. He believes it was a Government party, but he doesn't know where they went. He never saw them after that. (R. 4483.)

In the portion of the journey he made on the river from Bluff to Copper Canyon he had no difficulties to speak of. He was stuck a couple of times on sand bars, but he tried to keep in the deepest channel and avoid all the sand bars he could, and he has no recollection of more than two occasions when he got onto one. On this trip he carried two months' supplies with him and believes the whole outfit

would weigh about six hundred pounds. (R. 4484.) He doesn't know how much water his boat would draw when loaded.

When he would come to a rapid, he would go straight through and didn't portage or line his boats. (R. 4485.)

Cross-examination (R., Vol. 25, pp. 4485–4486):

This was the only trip he ever made on the river, and after he started his store he didn't know that any of them were actually placer miners but he sold supplies to those men. (R. 4485.)

When he got through on the trip he made he gave his boat to an Indian. (R. 4486.)

J. H. WOODS

For Defendant

(Record, Vol. 26, pp. 4489–4512)

His name is Joseph H. Woods. He resides at 134 E Street, Salt Lake City, Utah, and is fifty-four years old. (R. 4489–4490.)

He resided in San Juan County from about 1883 until 1923. The early part of his life was spent at Bluff, on the San Juan River, and later at Monticello, the county seat, San Juan County. (R. 4489.)

He was county assessor of San Juan County twice and commissioner for about twelve years at different times. In 1894 he worked on the placers on the San Juan River, being employed by a man named

John Bryce, and he joined the party at Mexican Hat. (R. 4490.)

At the camp where he joined Mr. Bryce there were lumber, supplies, and tools; and Mr. Bryce had three boats. (R. 4390–4491.) He had become acquainted with Mr. Bryce at Bluff before he entered his employ, but didn't see Mr. Bryce make the boats. (R. 4491.) He was employed by Mr. Bryce at Bluff, and then went down to Mexican Hat on horseback, and placer mined on the [San Juan] River from Mexican Hat to the Honaker Trail. They went down from Mexican Hat on the Honaker Trail on boats, and took down supplies, such as sluice boxes, copper plate, and equipment that goes with placer mining. By way of the river, he would judge it would be about thirty to thirty-five miles from Mexican Hat to the Honaker Trail, and each boat carried a load of a thousand to fifteen hundred pounds. The boats were about fourteen feet long and seven feet wide; were built about one foot in depth, and the draft would be about ten inches when loaded. Other placer miners would pass them occasionally. (R. 4492–4493.) He doesn't recall the names of the men he saw, as they were just working along the river, placer mining, and were not residents of Bluff but people from the outside. The people of Bluff didn't do much in the way of mining in those days, as they were stock men and farmers. The boats belonging to the miners that passed him were much

the same as their own boats, "built for freighting." (R. 4483–4494.) They carried their supplies and their equipment in their boats. Generally speaking, he would say there were about four men to the boat; and he saw eight or ten different parties of miners between Mexican Hat and the Honaker Trail. (R. 4494–4495.) He was on the river for about six weeks, and the boom was still on. This was in the months of June and July. His knowledge as to the total number of miners working on the river would be based entirely on hearsay. The party he was with took out some gold, and he understood that it paid pretty well; but he has no knowledge of the gold content per cubic yard of the bars that he worked on. He doesn't know what was done with the gold that was taken out, as he was just working for Mr. Bryce. (R. 4495–4496.)

Cross-Examination (R. Vol. 26, pp. 4497–4503):

When he left the river he came out alone and on foot from Mexican Hat, and went on to Bluff on horseback. No one came out with him. He was there for six weeks in June and July, but he wouldn't be positive as to whether he was there all of the month of July. He believes that he was there most of the month of June, however. (R. 4497.)

When he was on the river in the month of June it was the latter part of the spring high-water season, and the water was going down. They

worked the bars that were convenient to the water's edge; as the river went down they would follow the bars down.

When he made the trip by boat from Mexican Hat to the Honaker Trail he encountered a number of rapids. While he was down there he believes that no additional supplies were brought in from Bluff. (R. 4498.) When he went he doesn't believe he carried any orders to Bluff to send in supplies.

While he was in there he didn't see any pack trains come down the Honaker Trail to bring supplies to the party he was with, or to any other placer miners.

In his capacity of assessor, he knows that the irrigated land in San Juan County is assessed at about fifty dollars an acre and the dry farm land at about ten dollars an acre. He knows that there is some irrigated land around Bluff that was assessed, while he was assessor, at about fifty dollars. There is very little dry farming around Bluff. He has done dry farming himself, over a considerable period of time. (R. 4499.)

He was assessor in San Juan County from 1908 to 1920; and the valuations he has given would fairly represent the valuations of the year 1920. He has cleared land for himself around Monticello, and it costs about six dollars an acre. The land in the raw state is covered with sagebrush and blue grass. In dry farming, scientifically, you

let it summer fallow, and only get a crop and farm it every other year. (R. 4500.) On the year they do farm it, the success of the crop depends on the rainfall. He believes they can dry farm with fifteen inches, "but to make it profitable you ought to have twenty inches." (R. 4500–4501.)

Lately in the San Juan country there have been a good many years when there isn't fifteen inches of rainfall. He doesn't believe that ordinarily a great amount of precipitation comes in a very short space of time, in twenty-four hours, with a rapid run-off. In that country a big rain is an inch or an inch and a half.

When he left the country in 1923, there were very few farms that had been cleared for dry farming; and they had been abandoned. (R. 4501.) There were some, to his knowledge, from which the people had moved away to different parts of the country; which were not being operated and farmed. He doesn't know whether this would be abandonment, or not, as they still owned them, and probably figured on coming back.

There was also land in the Monticello country, which was neither irrigated nor dry farmed, but used for grazing.

The assessed valuation of that land in 1920 would average probably about two dollars an acre. The mountain range, patented ground, would probably be assessed at two and a half dollars an acre. (R. 4502.)

Redirect Examination (R., Vol. 26, pp. 4503–4510):

In going down with the boats, supplies, and equipment, from Mexican Hat to the Honaker Trail through the rapids, he doesn't recall any difficulties encountered in controlling the boats, or going forward on the journey, and they did not get hung up on sand bars. (R. 4503.)

He didn't meet with any obstructions of any kind between Mexican Hat and the Honaker Trail. (R. 4504.)

The assessed valuation in San Juan County is about sixty per cent of the market value.

The land in the vicinity of Monticello is covered with sage brush and bluegrass. The bluegrass is peculiar to that country, and it grows up so that it can be cut for hay. It is what is also known as blue stem. (R. 4505.) The sage brush will grow as high as ten feet in places and indicates that the soil is rich. All kinds of small grain, vegetables, and garden truck will grow on dry farms in that section of the country. The oats and wheat in that country have been exhibited at fairs, and so forth. He knows that San Juan dry farm oats took the prize one season at either the state fair, or the world's fair. (R. 4506–4507.) He knows that in every part of the country where dry farming is practised that the amount of precipitation has an effect on the crop raised. Occasionally in the San Juan County there is a dry season, but he

doesn't know of any season where dry farming is being carried on scientifically that has been a failure. The failures have been where they tried to farm each year.

During the last twenty-five years he would say that four or five years were failures, where they farmed it each year. (R. 4507.)

He has a pamphlet that was got out by a committee of the commissioners, appointed for that purpose, about 1920, which is an industrial survey of San Juan County, made at the time pursuant to the resolution of the county commissioners of San Juan County, and compiled from official records of the county. (R. 4508–4509.)

Recross-Examination (R. Vol. 26, pp. 4510–4512):

He doesn't know how many farms there were in San Juan County in 1920, but he would say that four hundred and five would be a very low estimate, in his judgment, as he believes there would be more dry farms than that. (R. 4510–4511.)

(In connection with Mr. Wood's testimony, page 13, of the fourteenth census of the United States, for the year 1920, was introduced, showing there were four hundred and five farms in San Juan County, Utah.) (R. 4511.)

He doesn't know of any other pamphlet similar to Defendant's Exhibit No. 14 that would be of a later date, which has been issued by the county. (R. 4512.)

ANNA M. BAYLES

For Defendant

(Record, Vol. 26, pp. 4512-4523)

She resides in Salt Lake City, Utah. At one time she lived in Bluff, San Juan County, Utah, having gone there in 1888, and remained there nine years. (R. 4512.) While she was there she worked in the San Juan Co-op. three different times as a clerk. She doesn't remember the dates, but she worked there a year steady at one time and twice afterwards at different times.

She remembers a gold placer mining boom on the San Juan River while she lived at Bluff. (R. 4513.)

The road goes down to the river from Bluff almost directly south, and the boats were hauled down this road. While she was in the store she sold supplies to miners many times. (R. 4514.) She knows that supplies were bought in the store and that they were taken down in boats. She has gone down to the San Juan River and has seen boats on the river. (R. 4515.)

Defendant's Exhibit No. 15 shows an old gentleman from New York, and placer miners, who were all going down the river in the boats. The picture was taken in the nineties some time. (R. 4516.) She saw these men on the river, and knows that after the boom was over placer miners went down the river in the winter time. Placer miners would come in every winter as a rule, from the mountains

in Colorado, and it was a matter of common knowledge that some of them went down the river in boats; others came with pack-animals. (R. 4517.)

She has seen quite a bit of San Juan gold, and has accepted it in the store in payment for goods. It had been melted and was in a solid piece. The pieces were called retorts, and were accepted in lieu of cash.

She also has a couple of rings on her finger, made of San Juan gold from the retorts. (R. 4518–4519.) One of the rings has a stone in it that is a San Juan garnet, which she secured from a Navajo Indian.

She doesn't know what the Co-op. Store did with the retort gold that she took in in trade. She believes it was sent off to the mint. (R. 4519–4520.)

Cross-examination (R. Vol. 26, pp. 4520–4523):

She doesn't remember any supplies ever being received while she was in the store, that were shipped in on the San Juan River in boats. The shipping point at that time, as she remembers, was from Durango, Colorado; and most of the goods came from there. Occasionally some came from Cortez. These came in by horses, and in later years they got merchandise from Thompson Springs. (R. 4520–4521.)

Before she went to Bluff she lived in Parowan, Iron County, Utah, and when she went out she landed at Thompson Springs.

From there she went to Monticello in a wagon, and then on horseback to Bluff. She went from Provo, Utah, to Greenriver by train.

She crossed the Green River in a ferry when she went out; coming in at one time she crossed in a wagon; but usually in the ferry. (R. 4521–4522.)

Some of the placer miners had burros, but she doesn't remember any horses, and couldn't say as to whether or not they had mules. (R. 4522–4523.)

ANNA A. THOMPSON

For Defendant

(Record, Vol. 28, pp. 4523–4529)

She resides in Salt Lake City, Utah, but has lived practically all of her life at Bluff [San Juan County, Utah]; that is, up until 1907; and is forty-five years old. (R. 4523–4524.) While she lived at Bluff she was a clerk in Adam's Store for a time, and during this time sold goods to miners many times. There was a carpenter's bench at the back of her mother's kitchen, and there were two boats built there that were taken down to the river on wagons, just south of Bluff.

She also recalls going past the Co-op. Store, and seeing a man with a boat on two trestles. He was on top of the boat, fixing the bottom of it. (R. 4525–4526.) She doesn't know which way that boat went. She has seen boats go down to the river past where her mother lives many times. She wouldn't attempt to make an approximate estimate

of the number of times, but knows that it was more than once or twice.

When she was working at the store they never took money from miners; it was always the retort. She took in a good deal of that.

Her husband came down the San Juan River, from Fruitland, New Mexico, in a boat, about 1905, she believes. Her mother afterwards sold this boat to a miner to use in taking his supplies down the river from Bluff. (R 4526–4527.)

Cross-Examination (R. Vol. 26, pp. 4527–4529):

As a girl she didn't do a great deal of horseback riding around Bluff, but she has ridden from La Sal [to Bluff] and back and forth several times. She went alone or with the mail carrier. She has gone over to the Navajo Reservation several times.

She has forded the San Juan River on horseback, and has gone across it in boats. She would sometimes cross just down from Bluff, and sometimes [crossed] with the ferry. (R. 4527.)

The Indians had a boat there to ferry their wool and supplies across. She never forded the river where the boats were, but it was above Bluff, perhaps a mile or so.

She doesn't remember whether it was a common thing for the men and ladies of Bluff to ford the river on horseback from time to time. She has forded it several times, but the horse would have

to swim across the main current, and every time she crossed she got her feet wet. (R. 4528–4529.)

MRS. KUMEN JONES

For Defendant

(Record, Vol. 26, pp. 4529–4530)

It was stipulated that she would testify substantially the same as did Mrs. Bayles. (R. 4529–4530.)

ZEKE JOHNSON

For Defendant

(Record, Vol. 26, pp. 4531–4585)

He was originally named Ezekial; resides in Salt Lake City, Utah; his present occupation is guide and outfitter in the summer, and in the winter he works for Zion's Wholesale Grocery. He has been engaged in his present occupations since 1907. (R. 4531.)

The Natural Bridges and the Colorado and the San Juan Rivers have been the main places that he takes tourists. (R. 4531–4532.)

He first went to the San Juan River in 1894. He came from Flagstaff, Arizona, and struck the San Juan at the mouth of Copper Canyon. His destination was the lower Gable Camp. He then spent most of the time for four years on the river. Upon his arrival he didn't see any boats at Gable Camp. The first boat he saw on the San Juan was at William's Bar, at the mouth of Copper Canyon, where he first touched the river. (R. 4532.) Zahn's Camp and Gable Camp are the same.

He was then shown Defendant's Exhibit No. 16, and he recognized the large boat that is shown in the picture. He first saw the boat at William's Bar, about one mile up the river from the mouth of Copper Canyon, and between eight and ten miles from Gable Camp. (R. 4533.)

The boat as shown in the Exhibit is located at Zahn's, or the lower Gable Camp. The boat had been taken up the river from there to above Copper Canyon, where he saw it. There was, also, a small boat in the party, like the one shown in the Exhibit. He recognizes the man standing immediately in front of the boiler, between the two other figures, as Cap Williams. (R. 4534.) After his arrival on the river he helped carry some heavy tools and implements, and some heavy iron, out of the boat. It is hard for him to estimate the weight of the big boiler and engine, and other equipment and material that was on the boat. But he would imagine that the boiler and engine would weigh about eight or ten thousand pounds. (R. 4535–4536.) The other material and supplies that he helped carry out would weigh several hundred pounds, and it was unloaded above Copper Canyon. He supposed it was used there, although he never saw it after that; but it had been brought there for that purpose.

There was a wagon road from Flagstaff to Copper Canyon. And there was a road from Gable Camp to a point above Copper Canyon, where the

boat was unloaded. It ran right along the river; not on the bed, but on the rim part of the way and part of the way on the shore. (R. 4536.)

While he was on the river he did very little rafting, but he did do some, for a distance of, he believes, two or three miles, up and down from Honaker Trail.

During the period that he was on the river he saw parties come down the river in boats, carrying their supplies. Sometimes there would be a party every week or two, or maybe two or three boats in a week, and then there would be five or six months go by in which there wouldn't be any. It would depend on the conditions on the river, a little; and on the demand for supplies by the miners. (R. 4537.)

He has been on the river in boats or rafts at different points below Gable Camp. He has been in there with parties on the river, and has been on the San Juan and Colorado Rivers every place that it is possible to get on it, he believes, from Bluff to Lees Ferry. He doesn't mean that he has been on the river traveling in boats, but has been down to the river or crossed it in various places. (R. 4538.)

At the times he has gone up or down the river in boats or rafts, he never had any particular trouble; was never stuck on the sand bars, as in the district where he worked there are no sand bars. (R. 4539.)

They were in Bluff at the time they went to Honaker trail; they went down with burros, down the Honaker trail, carried their supplies in on burros. He never had a boat there, at all. (R. 4539.)

There was a place or two where he couldn't get with burros, that he built a raft to use. He took supplies down a ways and then brought them back on the same little raft. (R. 4539.) He went on the raft only this mile or two below Honaker trail; in placer mining he used a raft to get down a little ways where he couldn't get with the burros with the supplies. They didn't have any boat at all, just working on the bars. (R. 4539–4540.)

When he got down to Honaker Trail he built a raft, and went up and down the river on it, so as to get across; but in his earlier experience, when he went to the river at a point above Copper Canyon, he didn't go on the river up and down in boats. (R. 4540.)

The rafting he did on the river between Gable Camp and Bluff was in the course of working the bars, and would probably be six or seven miles of rafting altogether.

He has crossed the river, he believes, every year or two ever since he has been in the country; from Bluff down to the mouth of Cottonwood Canyon.

Cottonwood Canyon is located about five miles above the junction of the San Juan and the Colorado Rivers.

He has had parties along the rim of the San Juan in various years. (R. 4541.)

When he has been able to cross the river with horses the water would come a little more than belly deep. (R. 4541–4542.) He has attempted to cross with horses when the water was not low, to his sorrow, and his horse had to swim. He believes that he has crossed the San Juan River in every month of the year. The parties he takes in are taken in in the summer. He opens his business the fifteenth of May, and it continues to the first or middle of November; August, September, and October being his big months. (R. 4542–4543.)

He has seen the San Juan River when there wasn't any water in it, but aside from this one time he doesn't believe he has ever seen it narrower than one hundred and fifty or two hundred feet, and where it was that narrow it would be confined by the canyon walls.

He has crossed the Colorado River a good many times in boats, having crossed at Hite, Hole-in-the-Rock, and at Moab. There are no regular ferries anywhere on the Colorado River that he knows of now, but there used to be ferries at Hite. (R. 4543–4544.)

In his opinion, the use of the San Juan River would be for boats that carried two or three tons of supplies, or possibly more, flat bottomed boats, like the one shown in Defendant's Exhibit No. 16. (R. 4545–4546.)

While he was working the placers on the San Juan River he had an opportunity to learn the condition of the beds that he worked, and he has worked dirt from which he saved twenty-two dollars per cubic yard. There were some pockets that were richer than that, and he never worked any dirt that went less than ten dollars. He knows that the operations carried on by his party were financially successful. The men in charge of the party he was with were three partners, James Atwood, Frank Tallman, and Andy Henniger. They took him in as a partner. They took out enough gold to pay their expenses; and sent out a man to Denver and other places to sell the claims. A sale was made and some money was paid down. (R. 4547–4548.) In the extraction of gold from the beds of the San Juan River, the main difficulty encountered was having the power to work the dirt, as to work it successfully it was necessary to have hydraulic or heavy machinery. There were no power lines in there; and the gold was flour gold. (R. 4548.) They would retort their gold by using copper plates with quicksilver on them. The gold would adhere to the quicksilver and form an amalgam. This was scraped off the copper plates and put on a fire which would drive the quicksilver off, and leave the gold "in a nice little nugget." (R. 4549.) It would be poured into a crucible and melted, or sometimes just put on a shovel. Other times they would use an iron pot with a tight lid,

and a pipe that ran from the pot to a bucket of water. The quicksilver would evaporate, and they would save it in the water. Most of the time gold was sold to the First National Bank, of Durango, Colorado. (R. 4549–4550.)

He has observed boats operated on the Colorado River from Hite to Lees Ferry. He has never seen any come up stream; has only heard of them. He has never done any boating on the Colorado himself, except crossing the river.

He is familiar with the scenic sections of the west, including Southern Utah, Northern Arizona, Western Colorado, and New Mexico. In Colorado he is familiar with the Mesa Verde National Park; in New Mexico and Arizona with the Navajo Reserve, Monument Valley, Navajo Monument, the Painted Desert, and the Grand Canyon of the Colorado River, down the Bright Angel Trail. He believes the country referred to is the scenic section of the Pacific slope. (R. 4950–4952.)

He has been on one small trip on the Green River, between Greenriver, Utah, and the junction. He considers the section from Hite down on the Colorado River as very scenic, and he has been to the rim along Cataract Canyon. There he has looked down and seen Cataract Canyon from the rim, and he considers it very scenic.

In going from Hite down the Colorado River there is not a trail along the top of the rim all the way. There are places where he came in and fol-

lowed along for miles, and then had to go back to get around a certain canyon, and then back to the rim again. When he crosses the Colorado River at Hite he goes up White Canyon or up Trachyte, depending on the way he is going. Going to the San Juan he goes up White Canyon. (R. 4552.) He doesn't go to the San Juan from that direction. He only goes to Bluff; but one can go in a good many places. He has crossed the San Juan River at Clay Hill Crossing, and there is a trail from there up to Hite. He has knowledge of the recent interest in the Zion's Park section, and also in the north rim of the Grand Canyon and various other scenic attractions which have been developed in the west during the past years. He believes that all that is needed in that country is more advertising to attract tourist travel to the San Juan and lower Colorado Rivers, and that with reasonable advertising it would be a commercial proposition. (R. 4553.)

He hasn't lost any money on his expeditions.

He has personal knowledge of copper showings in White Canyon and Copper Canyon. These are substantial, and there is a wide zone of mineralization through there. He knows of a substantial amount of timber in the Elk Ridge and Blue Mountain sections, and the grazing and dry-farming areas of the San Juan country. (R. 4554.)

Cross-Examination (R. Vol. 26, pp. 4555–4583):

Defts. Exhibit No. 16 was taken at lower Gable, or Zahn's Camp. When he first saw the outfit it was eight or ten miles above there, about a mile above Copper Canyon, on William's Bar. There is a trail leading into Copper Canyon there. The outfit was right on the trail that comes down the canyon to the river bar. (R. 4555.) The picture was taken at Zahn's Camp, but it was taken before he saw the boat. He worked a bar at Zahn's Camp, or lower Gable, but didn't use this outfit [shown in Defendants Exhibit No. 16]. The last time he saw the outfit it was right on William's Bar. He has been back there since; it is not there now, and he doesn't know where it went to. (R. 4556.) When he saw it there were four men working in connection with the boat, and the boiler and stack that appear were not in connection with power on the boat. The boat didn't have any power on it, and it was not in operation when he saw it; it was just tied to the bank of the river. The boiler and stack were taken there to use hydraulic power for placer mining, but he never saw the boiler set up.

He first came in to the San Juan River at the mouth of Copper Canyon overland. (R. 4557.) From Copper Canyon he went down to Gable, or Zahn's Camp with wagons, along the side of the river. He didn't traverse the section between Copper Canyon and Zahn's Camp all the way in a boat.

He went up above Zahn's Camp a mile by rowing the boat, and sometimes he had a sail on it. He didn't have to tow, as two men were always able to row it, with two pairs of oars. (R. 4558.)

He has been down the river from Zahn's Camp a mile in a row boat; he used a stick, and punched it along. Part of the time he poled it up stream, and part of the time he rowed, but didn't tow it. He has never been on any other section of the river between Zahn's Camp and the mouth of the San Juan River in a boat, except the two he has just mentioned; and the traveling on the river around Zahn's Camp was not a daily operation. He would say he made the trip half a dozen times in the four years. When he wanted a load of wood, he would go up or down the river and get the driftwood, and come back. (R. 4559.)

During the time he was in there it was necessary for his party to be resupplied and to get machinery and tools, and picks and shovels, which were brought in by wagon, some from Flagstaff, but mostly from Bluff. They would come down Copper Canyon and across at Nokai to get to camp.

All the time he was down there he never got any supplies down the river in boats. He personally went to Bluff to get supplies, but didn't go in a boat; went with a team or pack train. (R. 4560.)

He didn't go in a boat because it was quicker to go with a team, and the big scow didn't come

down the stream while he was at Zahn's Camp. This scow belonged to Cap Williams.

In 1895 he went from Bluff City to Honaker with burros, and not by boat, as it was easier to get there with burros. (R. 4561.) He wanted to take care of his burros, and he wasn't a boatman.

When he got down into Honaker he established a camp at the trail; had picks and shovels, food and supplies, rocker and copperplate, and gold pans, but he didn't have a boat and he didn't make a boat or borrow one from anybody.

The trips he made up or down were made on a raft that he built, about sixteen feet long and five feet wide. (R. 4562.)

He went up the river a mile or a mile and a half. Two men would tow, and one man would push from the bank of the river. It took three men to tow it up. The raft would be loaded with their camping supplies, picks and shovels, and they would remain up there a week or ten days or longer and work the river. They were working at the low-water mark, and after the river went down they followed it right down, but they didn't put out any location notices. (R. 4563.)

This was in October of the first year. He doesn't remember just what month it was in the second year, but it was late in the fall or early winter. When he got through he went down to the headquarters camp at Honaker Trail, and went down below about a mile and a half, or two miles, and

stayed there for ten days or two weeks in November or early December. When they got through they turned the raft loose down the river. (R. 4564.) He got back to Honaker by towing the raft back up to the end of the trail, and it was pretty hard work. He has done harder work than towing a raft upstream in December, but he admits it was pretty hard work. He didn't have to get in the water; they could do it all from the land. When he got through at Honaker he went to Bluff City and stayed the rest of the season, and the next season went back to Gable Camp. (R. 4565.) He went down overland, and took supplies; he had a boat down at Zahn's Camp all the time. Part of the time in the winter he spent at the Honaker Trail, but in the summer he spent most of the time at Zahn's Camp. When he got back to Zahn's Camp on this trip he used the river just to get wood. He would row the boat, and sometimes had a sail when the wind was blowing. He would push it with a stick coming upstream, but he didn't tow it. (R. 4566–4567.) The water was wider there, but it was not as swift as up around the Honaker Trail. He spent the better part of the summer of 1896 there, and the party got supplies from Bluff, overland. None came down the river in boats. He went out from time to time himself, and always went out overland. This continued until about November, 1896, and then some other persons and he went back to Honaker overland.

This year he didn't build a raft; just worked the sections of the river he could reach, and stayed possibly two months; he believes the latter part of October, November, and December. He was home for Christmas. While he was at Honaker Trail he never saw any boats go upstream, but he saw a party or two go down. (R. 4567–4568.)

He went back to Bluff that winter, overland, and he believes in the spring of 1897 he went to the Colorado River, but was on the San Juan in July and August of that year.

After he left the Honaker Trail about January 1, 1897, he did not work any other section of the river, except at Zahn's Camp. He was back at Zahn's Camp in 1898. (R. 4568–4569.)

He didn't have a boat in 1898, and, while he hasn't been placer mining since 1898, he has been in the country ever since, but went into the stock business at that time.

He had a raft in the Soda Basin country once. That was the first winter he was at the Honaker Trail. (R. 4570.) He went from Bluff to the Soda Basin with burros, some seventeen or eighteen miles, and he built a little raft to cross the river. He has crossed the river at Bluff many times, in boats maintained there by the trader; but this is not much of an operation to cross in these boats. This is all of his experience. (R. 4571.)

When he goes into the San Juan country as guide he takes ladies on his trips, and carries camp equipment with him. He has crossed the San Juan River immediately south of Bluff, on horseback. (R. 4572.)

He has not crossed at Bluff with his parties; just by himself; waded through, and has crossed a good many times there where it was not necessary to swim his horses, both above and below Bluff. He has also crossed at Sand Island, about five miles below Bluff; not with parties, just by himself. He has crossed there when it was not necessary to swim his horses. He has crossed at the mouth of Chinlé with a party. (R. 4573.) He didn't swim his horses there, either. He has crossed at Mexican Hat, both on the bridge and on the river, and it was not necessary to swim his horses. He has crossed at Clay Hill Crossing with parties and by himself, and sometimes the horses would have to swim, and sometimes they wouldn't. He has crossed at this point about twenty times.

He knows a place called Piute, or Indian Farms. But he has never been there; there are several Indian Piute Farms, and he doesn't know just which one the reference is to. (R. 4574–4575.)

He has crossed by himself on horseback at the mouth of Copper Canyon; but he has never crossed burros there or never crossed at the Honaker Trail with burros. When he crossed at Copper Canyon it was not necessary to swim his horses, but he has

never crossed on foot at Copper Canyon. He has never crossed on foot at the mouth of Nokai, but he has crossed at the mouth of Cottonwood Canyon; some people call it San Juan Canyon and some call it Cottonwood. It was necessary to swim the horses sometimes, and sometimes it was not. He believes that he has crossed about ten times there. To get into Cottonwood Canyon you follow the ridge right straight through to the head of Cottonwood, and then go straight down it on the north side of the San Juan River. (R. 4575–4576.) He hasn't crossed the river at any place else. When he was down at Zahn's Camp he was working way up high on the Zahn Bar, and carried the dirt on burros to the bank of the river. He didn't work any of the lower bars. (R. 4576.)

He has had experience with floods on the San Juan River, other than the usual, customary, spring rise. These usually occur in the latter part of July, or August; very seldom in September. There would be quite a big rise in the river about every year.

He built a house on the river bar at Zahn's Camp, and a friend advised him to build it higher. He told him the high water would never reach that spot, but the house washed away that fall. It was a pretty big rise. (R. 4577–4578.)

He has crossed the Colorado River at Hole-in-the-Rock four times, with a party of both men and women. They had come from Bluff, or the other

way, as he operated both ways. At this crossing there are gravel bars on both sides of the river. (R. 4578.) The horses crossed easily and without swimming, although he had to swim them once, as it depends on the condition of the river.

He has also crossed at Hite, and this crossing is gravel mostly. The crossing is below the rapids, but he has had to swim his horse every time he crossed there. He believes he has crossed there ten times. There was a boat there at one time, and he would take his outfit over in the boat, and the stock would swim across. If he only had two he would tow them, but when he had a bunch he would swim them. He hasn't crossed at Hite for seven or eight years.

There is a trail up from Hole-in-the-Rock on both sides of the river; the one on the northwest side is a pretty tough trail. It used to be an old road but is just a pack trail now. (R. 4579–4581.)

His outfitting point for these trips is at Blanding, Utah, and the boats that he spoke of going down the Colorado were canvas boats that Dave Rust built. Outside of these boats he has never seen any others going down the Colorado River.

He was at Hite three years ago, but didn't cross, and nobody was there at that time. There are no placer miners left over in the San Juan Canyon that he knows of, but there is one man at the mouth of Red Canyon, on the Colorado River; a man by the name of Carpenter, whom he saw last June.

He believes he is the only one left down there. (R. 4581–4582.)

He doesn't cross at Lees Ferry, and he hasn't taken any people across at Lees Ferry lately. He has been down to Lees Ferry many times overland on both sides of the river; and has crossed there with wagons many times, but not since he was in the tourist business. He doesn't cross at Lees Ferry at all, and he has never gone from Hite to Lees Ferry on the river, only on the rim on both sides in a great many places. (R. 4582–4583.)

Redirect Examination (R., Vol. 26, pp. 4583–4584):

He has not taken boats, but has used wagons or horses in making trips up and down the Colorado, and when he was at Gable, or Zahn's Camp he had a team or wagon there. For a long time there was a big boat with a wheel on it to pump water up, but that was a stationary boat. They had a small row-boat there, but he preferred to go up to Bluff with his team and wagon instead of attempting to take the boat upstream. He would go up and get his supplies and bring the team back. He didn't own any boat at Bluff. When he brought his burros down the Honaker Trail he didn't own any boat. He didn't own any boat at any of the times he left Bluff. But he had a land outfit and used that.

When he was at the Gable Camp they would sail up the river for a Sunday ride for a mile or two to

get a load of wood. They would use just an improvised sail. (R. 4583–4584.)

Recross-Examination (R., Vol. 26, p. 4585):

The boat shown [in Defendant's Exhibit No. 16] was between twenty-five and thirty-five feet long and eleven or twelve feet wide. The boat tied behind it was about the same kind of rowboat he used at Zahn's Camp. (R. 4585.)

CHRISTIAN L. CHRISTIANSON

For Defendant

(Record, Vol. 26, pp. 4586–4602)

He lives at Moab, Utah, and first went to Bluff in 1890. He came from Lees Ferry, through Utah, over Hall's Ferry. (R. 4586.) He is seventy-four years old. (R. 4592.)

He crossed the Colorado River and then came overland to Bluff. He understood the Navajo language, and for a time acted as interpreter.

He moved from Bluff in 1896. About 1893 there was a store established at Rincon, and he worked there. He took some flour and supplies down in a skiff. (R. 4587.) The skiff was about sixteen feet long, eight feet wide, and eighteen inches deep, and on the first trip it was loaded with twenty hundred. He made a similar trip with a skiff, loaded with supplies, from Bluff down to Rincon, later on. On his first trip down he went over sand waves for three or four hundred yards, which were quite dif-

ficult to ride on. The skiff got through by turning off crosswise, and he held on to the sides. He was right in the middle of the sand waves. (R. 4588.)

He had had some former experience with boats but not with sand waves. This was the only difficulty he encountered on this trip. He was then down at the store for a couple of months, and while there he saw a big lumber raft. It was about five thousand feet and was bolted together to make it safe. There were five men on it, with supplies. They appeared to have poles, probably to steer with. They were going down to the Gable Camp; and he believes he knew one of them. This was in the spring of the year. (R. 4589.)

He knew a placer miner by the name of Mendenhall, for whom he worked, at what he believes is called the Goose Neck, below Mexican Hat, down below what is known as the Mendenhall Trail. Mendenhall hired him at Bluff, and he rode down on a horse. (R. 4590.) Mendenhall went down with the skiff, and was there when Christianson worked for him. Mendenhall had the skiffs all the time that he worked for him, although he didn't see the skiffs up at Bluff. Mendenhall told him that he went down the river by skiffs, and he saw him later at the camp, and worked for him. He believes he was there nineteen or twenty-one days. (R. 4591.)

During his residence in Bluff he clerked in Fred Adams's store for about two months. This was in about 1895. While he was in the store he sold

supplies to miners who were working down the river. These supplies were loaded on wagons and taken down a lane to the river, on a road that leads out from town. (R. 4592.)

He knew a man by the name of Rocky Powers, whom they called "Old Rocky." He first met him at Dandy Crossing about 1891, when he was moving his family from Utah. Powers was at Dandy Crossing, although he also lived in Bluff. When he lived in Bluff he was a great trapper, and trapped up and down the San Juan River; getting lots of beaver.

He has crossed the Colorado at Dandy Crossing in a boat, and had some animals with him that had to swim. (R. 4592–4593.) When he crossed at Hall's Crossing a German trapper took the wagon to pieces and took it across. He swam the cattle across. The German trapper's name was Mesken, and he lived in that section, trapping up and down the river. (R. 4594.)

Cross-Examination (R., Vol. 26, pp. 4594–4602):

The place called Rincon is fourteen or fifteen miles down the river below Bluff, and Chinle Creek comes in a little below, according to his recollections. (R. 4594.)

The store was on Comb Wash. There are no rapids that far, and he didn't encounter or stick on any sand bars. The boat was about sixteen

feet long and eight feet wide and the sides were eighteen-inch plank. When it was loaded, he believes, the water came up on the sides eight or nine inches. (R. 4595.)

He doesn't remember the month in which he made the first trip, but it was during shearing time, and he would say it was in March or April. The second trip wasn't two weeks after the first trip.

He went back to Bluff from Rincon in a wagon, taking produce, wool, and hides back. The store at Rincon was a branch of the Bluff Co-op., a large organization, and L. H. Redd was the superintendent at the time. Mr. Redd has been dead for two or three years. (R. 4596.)

After he got down he was a clerk in the store, and there was other merchandise there besides what he brought down. The other merchandise was brought by wagon. When they would come down to take produce they had secured, they would bring provisions down that way. He was trading with the Navajos, and he got Indian wool, sheep pelts and goat hides, and blankets from them. He didn't take this stuff up to Bluff in a boat, as he would have had to tow it up, and it was pretty swift in places; it was easier to go up by team. He never took the boat back to Bluff. It was used down there to cross Indians over the river. (R. 4596–4597.)

When he came down the second time he bought a new boat, as he had lost the other one. He doesn't

know what it cost, but lumber was very high in the country. He didn't get the flour wet in the sand waves, and it was not covered with canvas. He had his bedding on it, and didn't get the bedding wet. The sand waves weren't very high.

When he came from Lees Ferry to Halls Crossing he came around by Kanab and into the Panguitch country on a road. He found a family that was moving to Bluff, and he accompanied them across the country. He had a couple of horses, and the man he traveled with, whose name was Perkins, hired him to go with him. (R. 4598.)

He had lived in Arizona for a number of years, and he went from there to Utah and into the Bluff country. He has crossed at Lees Ferry many times. On this trip where he went to Lees Ferry he didn't know he was going to Bluff, as he was going to visit his mother in Ephraim, Sanpete County, Utah. (R. 4598–4599.)

He went overland from Bluff to Dandy Crossing. This trip back was to get his family. He crossed at Halls Ferry when he went into the country. (R. 4600.)

When he started back from Bluff to get his family he couldn't answer why he didn't go from Bluff to the Colorado River in a boat. It wouldn't have served his purpose at all, because he would have landed down in the Colorado River; he, therefore, took a team from Bluff to Dandy Crossing. (R. 4601.)

He went out single-handed, and came back to Utah and brought his family out to Dandy Crossing. (R. 4602.)

Redirect Examination (R., Vol. 26, p. 4602):

He doesn't know of any place where the San Juan or Colorado Rivers touch Sanpete County. (R. 4602.)

Recalled (R., Vol. 26, pp. 4649–4650):

Further Cross-Examination (R., Vol. 26, p. 4649):

The purpose of taking two boats down the San Juan River was to use them as ferryboats.

He traded with the Indians, and brought them back and forth on the river. (R. 4649.)

Redirect Examination (R., Vol. 26, p. 4650):

With respect to the supplies they were loaded with, he used them, he believes, for an experiment, more than anything else. He took the supplies down in a wagon. There were wagons to take the Indian products up to Bluff. When these wagons came down they would bring supplies; he used the wagons both ways.

They lost the first boat; an Indian stole it.

He was the sheriff of San Juan County in 1902. (R. 4650.)

HARRY TAYLOR HOWLAND

For Defendant

(Record, Vol. 26, pp. 4603–4633)

He resides at Greenriver, Utah, and works for the Denver and Rio Grande Western Railroad Company. (R. 4603.) He was born in 1871. (R. 4634.)

He first went to Greenriver in 1893, from Crested Buttes, Colorado. (R. 4603.) It was his intention to go to Hite on a prospecting trip, but he changed his mind and went down the Green River close to the junction. There was a man with him by the name of Spry, and they prospected and trapped. They got some fox, cats, beaver, and coyotes. He believes they had one boat, about sixteen or eighteen feet long, three and a half feet wide at the bottom, and four at the top. They brought their skins back up the Green River on the boat. (R. 4604.) As near as he remembers, it was in December or January when he went down, during the trapping season, and the trip lasted about sixty days.

In 1894 he made a trip from Greenriver to Moab. He took his father on the trip, and he believes they had one boat. The trip was made in August, and his father went home from Moab, overland, to Denver, and he [Howland] trapped the river back. (R. 4605.) On this trip he went down the Green and up the Grand to Moab; then from Moab down to the junction, and up the Green River to Greenriver, Utah. He got some furs on this trip, similar

in character to those he got on his former trip, and he shipped them out to market from Greenriver, where he brought them on a boat. This boat was about the same, sixteen or eighteen feet long.

In 1895 he made a trip on the Green River. (R. 4606.) He went from Greenriver to Moab, taking his father, and a druggist from Denver, by the name of Bailey. They had two boats, and received compensation from Mr. Bailey for the trip. The object of the trip was hunting, fishing, and taking in the scenery.

They had a man along by the name of Jack Lawrence, who acted as an extra boatman. His father and Mr. Bailey didn't come back down the Colorado. His partner and he went back down the Colorado to the junction, and up the Green to Greenriver, Utah. This trip was made mostly in August and September, and he believes they did some trapping on the way back. (R. 4607.)

In 1897 he took a trip on the Green River with Jim Ross, his father, Mrs. Kendall, and his [Howland's] wife. His wife had a young baby with them on this trip. (R. 4608.) It was a baby in arms. They only made a short trip down the river, fifteen or twenty or twenty-five miles. They didn't carry life preservers along.

In 1897 he moved away from Greenriver, and came back in 1903 or 1904. During the time he was away he was in El Paso, Texas.

Immediately following his return to Greenriver, he made some short trips to Wolverton's Camp, and shortly after this he was away again for some years (R. 4609), and came back to Greenriver in 1908 or 1909. After he came back he made a trip on the Green River in the *Marguerite*. He went from Greenriver to Moab, and took between twenty-five and thirty men with him. They were called Salt Lake Boosters; were all Salt Lake business men. He believes this trip was in 1909. (R. 4610.) He was one of the crew. After they arrived at Moab they came back on the river to Wimmer's Ranch. The *Marguerite* was Wimmer's boat, and it was left there at the ranch.

In 1910 he made a trip down the Green River and up [Colorado River] to Indian Creek. He believes he had an eighteen-foot boat, with a three and a half or four foot beam. He took his wife and three boys with him. (R. 4611.) The oldest boy was about fourteen. He guesses the next one was about ten and the other about six.

On the trip with the Salt Lake Boosters there was another boat accompanying the *Marguerite*. It was a power boat, but he doesn't remember what boat it was. He believes it was a screw boat. The *Marguerite* had a paddle. (R. 4612.) This was a pleasure trip and he believes it was made in September. They didn't take any life preservers along with them. (R. 4613.) He couldn't say just where the picture [Defendant's Exhibit No. 17] was taken.

But he believes it was right around Greenriver some place, as this was where they were starting out from. He had made arrangements with Mr. Wolverton to meet him at the junction on the return trip, and to tow him back up to the San Rafael, but when he got to the junction Wolverton wasn't there, and he came up the Green River thirty-five or forty miles, and met Mr. Wolverton, who towed him up to Wimmer's Ranch. He believes he was a little fast in making the appointment, and got that far up the river before Wolverton met him. Wolverton had a power boat, which he believes was a side-wheeler.

He entered the employ of the Denver and Rio Grande Western Railroad Company about that time, and since then has only taken a few trips on the Green River in boats. These short trips would be down the river just a few miles; say, down to the San Rafael twenty-five miles.

In 1928 he made a trip from North Wash to Lees Ferry with the Galloways. The boats were made of either sixteen or eighteen foot lumber, and were put into the river at North Wash just above Hite. (R. 4615–4616.) He didn't get any water in these open boats on the river on this trip. (R. 4618.) Beginning with this last trip, the Colorado trip, he never had any difficulties or obstructions to his navigation on the river in the boats he has used. (R. 4618.)

He never had any serious trouble on any of the trips he has made in boats that had no power in them, in the way of sand bars, riffles, or rapid water, or anything else on the Green River and the portions of the Colorado River up above the junction from Moab. (R. 4618.)

If he did get out of the channel and hit a sand bar he would stop, push off, and go on, but he doesn't call that trouble. The same thing would be true as to difficulties or obstructions to the navigation in power boats; he never had any serious trouble. The boats that he used that didn't have any power would have twelve or fourteen inch draft, he believes. (R. 4619–4620.)

Cross-Examination (R., Vol. 26, pp. 4620–4632):

When he went down the river with the Denver people he went in the capacity of a guide, to show them where to hunt. Right below Greenriver there are quite a number of riffles. On the return trip in 1909, with the *Marguerite*, he believes they encountered an ice flow at Wimmer's Ranch that knocked a few paddles off the boat. (R. 4620.)

The reason he didn't go on up the Green River was because he couldn't make it at that time of year. On the return trip he left Moab right after Thanksgiving, and encountered a heavy flow of slush ice at the junction.

On the trip on which he took his family with him, and came up the river with Wolverton, they un-

loaded at Wolverton's Ranch because that was as far as Mr. Wolverton wanted to go.

He went over the riffles going down in a rowboat, and he took his whole outfit home, but he couldn't say that the reason Wolverton didn't go on up was because he couldn't make the grade in his boat. (R. 4621.)

The last time he saw the Wolverton boat and the *Marguerite* they were up above the bridge at Greenriver, Utah. He doesn't believe he has ever been with Wolverton or Wimmer when they came into Greenriver in their power boats. On the trips up the river in his rowboats he would tow them a good part of the way. He has been through the Slide with a rowboat, towed through there. He never made a trip upstream on either one of the rivers that he didn't have to always tow his boat. He didn't have to tow all the way; if he knew the river he could row, but there are certain places he could make it better by towing. (R. 4622.)

He tows the boat for a rest on account of the swiftness of the current; he supposes he could fight it in lots of places but it is easier to tow than to row. The Green River freezes over occasionally; not every year at his station, but he couldn't tell what it does further down the river. He has seen it frozen over. (R. 4623.)

He believes it was in 1905 or 1906 when he saw it frozen during January and February. He saw four horse teams cross on the ice. On the journey

down to the lower Colorado he went overland from Greenriver, and put his boats in the [Colorado] river at North Wash, just above Hite. He didn't encounter any rapids between North Wash and Lees Ferry. (R. 4624.) No white water at all. (R. 4624.) What they call "white water" on the Green River, are those riffles; what they call rapids is what is in the cataracts.

No place did he encounter any water that he would call white water. (R. 4624.) On this trip they encountered whirlpools, but he doesn't recall encountering any sand waves on the Colorado.

In his experience on the Green, and on that section of the Colorado formerly called the Grand, he would not find the sand in the channels shifting about, unless it was caused by some flood, or something like that, which would shift the channel. The channels generally appear in the same place every year, although there might be an obstruction formed from high water which would divert the current from what it had been the year before, and change the channel. He wouldn't say that the river bed had no permanency, as it has a permanency, and he can find deep water. (R. 4625.)

With the power boats he has never made a trip that he hasn't been stuck on a sand bar, and he has been stuck on sand bars with rowboats. He wasn't stuck on a sand bar on the Colorado River from North Wash to Lees Ferry. He couldn't say that he had never made one trip on the Green or the

Grand Rivers that he wasn't stuck on a sand bar, because he has been stuck on sand bars, and it is a frequent occurrence. (R. 4626.)

To a man operating a boat on the Green River one sand bar more or less is not very much in his life. (R. 4627.)

He identifies his signature on a statement. (Complainant's Exhibit No. 630, being a statement given to the Government by Harry T. Howland, dated May 18, 1928, at Greenriver, Utah.) (R. 4627.)

He was subpœnaed by the Government, but he doesn't know why he wasn't called. Mr. Ryan prepared this statement right there at the river. [Mr. Ryan questioned him about his trips on the river, and he told him his experiences.] (R. 4627–4628.)

He believes the statement given to Mr. Ryan is in substance the same as he has testified to, except that he doesn't remember encountering any sand waves on the Colorado River trip. (R. 4631–4632.)

He saw sand waves once on the Grand, but he never saw any on the Colorado; that is, on the lower Colorado. (R. 4632.)

Further examination (R., Vol. 26, pp. 4632–4633):

In coming back up the river he would try to take advantage of back water, back of the islands, and tried to get out of the current. He wouldn't try to go in the deepest water, as he would look for the easiest way. (R. 4632–4633.)

HARRY J. HOWLAND

For Defendant

(Record, Vol. 26, pp. 4633–4650)

He resides at Greenriver Utah, and is the son of Harry T. Howland, who just testified. He is twenty-nine years old, and was not visited by Mr. Ryan at the same time his father was.

He took a trip in 1910 with his father to Indian Creek. (R. 4633–4634.) On this trip they got two deer, just below Indian Creek, on the Colorado River, and they transported the deer in their boat until they ate it up; they also brought some home. He was ten years old at this time, and he doesn't recall any difficulties that were encountered in navigating the boat.

As he grew older he had occasion to make other trips on the Green River, and in 1915 he took a trip; went just a little below Valentine Bottom, about one hundred miles down the river. (R. 4634–4635.) The trip was made in the middle of October, and he came back about the first of December. This was a trapping and hunting trip, and his brother went with him. They got some furs; fox, coyotes, badgers, and various other furs, and brought them up in a boat to Greenriver and shipped them.

He made a trip of the same character the following year; practically the same trip, and his brother was with him. They left Greenriver on October twenty-second and came back in December.

They got a supply of furs on this trip. (R. 4636.) They brought them up by boat to Greenriver, and encountered no difficulties on the trip.

He believes in the fall of 1921 he was down on the lower Colorado River, with Mr. Wimmer, when he was supplying the survey outfits from Hall's Crossing by boat. He believes there were four outfits of surveyors in there at that time.

He made several trips above Hall's Crossing, fifteen or twenty miles, looking for Chenoweth's outfit, and when they located him, took him up supplies from Hall's Crossing. (R. 4637.) The boat was about twenty feet long, five feet wide on top, and four at the bottom. It had a two-horsepower Evinrude motor. He supposes going up the river at certain times they would have a thousand or fifteen hundred pounds on, when they were moving camp, but most generally would have four or five hundred pounds on. He believes he went to what is known as Rock Creek, below Escalante, and took supplies from Hall's Crossing in the same motor boat he has just described. Mr. Tom Wimmer was with him. (R. 4638.) He was with his father when he went with the Galloways from North Wash down to Lees Ferry.

In the boats that he has named, and the trips that he has taken in the boats that were not power boats, he didn't have any difficulties, except the current coming upstream. It was a little difficult to row against it and not as easy as going down,

but as far as sand bars and such things, there was no need of getting stuck, as he followed the channel.

On the lower Colorado River with the power boat, he didn't encounter any difficulties with sand bars whatsoever. In going upstream with the two horsepower motor, along Bull Frog Rapid there is a wash comes in, which is the stiffest water they encountered. He used to help with the oars going over that. Otherwise he had no difficulties. (R. 4639.) He got over the Bull Frog Rapids with the two-horsepower engine, and the assistance that he gave with the oars; went over a number of times, although he couldn't say how many, as they were down there ten or fifteen days before they met Chenoweth's outfit, and he used to go up every day or two just to be doing something. This was in the latter part of October and November. (R. 4640.)

Cross-examination. (R. Vol. 26, pp. 4640–4648.)

He has been on the Green River with a power boat, but not on any long trips; just operated around the bridge there [at Greenriver]. (R. 4640.)

He has never been down as far as Wimmer's Ranch in a power boat. He has taken three trips down the Green River in a rowboat, once when he was ten years old and the other times in 1915 and 1916. Those were the only trips he ever took on the Green River in a rowboat.

He doesn't recall touching bottom between Green-river and the mouth of the San Rafael River, although he might have scraped a rock some place ascending, but he didn't scrape the rocks at places because the water was so shallow he couldn't get over. He always had plenty of water, and both trips were made down there in the months of October and November, and over the riffles he had plenty of water, and never touched bottom. He doesn't recall sticking on a sand bar. Possibly he hit sand bars coming up, but not going down at any place; that was true of both trips.

Coming upstream he rowed practically all the way. (R. 4642.) He didn't get on any sand bars coming up the river, unless he might have run up some backwater, as he generally would take advantage of backwater if he was rowing. Once in a while, coming to a sand bar that they knew was there, they would try to go over it; would possibly get stuck, and have to back out and go around.

But these were the only sand bars he was stuck on, and he was never stuck when he stayed out in the channel. He would suppose that his oars touched bottom occasionally, but he has no recollection of it. (R. 4643.) There are all depths of water there, and he supposes the oars touched bottom some places, but he hasn't any recollection of any particular spot.

He went into the lower Colorado River in 1921, by the way of Hanksville and down the Grand

Gulch to Hall's Crossing. He didn't take a boat with him as they were already there, and he had nothing to do with getting the boats down. He has no recollection of having seen those particular boats at Greenriver.

When he went up the river looking for Mr. Chenoweth he would go up light, and hauled Mr. Chenoweth's supplies up. (R. 4644.)

He believes there was only one trip made with supplies, but they moved his camp various places, and they usually stayed with Mr. Chenoweth. He has been up Bull Frog Rapids loaded more than once. They had a base of supplies at Hall's Crossing, and never knew what they wanted and used to go down and get things. Sometimes he could make it up Bull Frog Rapids without help. It was just according to how he hit the current; most of the time he had to help it with the oars. But they were never loaded very heavy. He would suppose the boats would draw five or six inches light, and loaded maybe eight or nine inches. (R. 4644–4645.)

He believes the Evinrude needed a foot of water to operate in, but this was his first experience with power boats. Mr. Wimmer operated the boat, and he was in the capacity of a helper and boatman. He stayed down there that year in the neighborhood of forty-five days, and when he was ready to come out he came out by the way of Hall's Crossing and Hanksville with a pack outfit, and packed all the way back to Greenriver.

When he went down the river in 1928 he entered the river at North Wash, and didn't encounter anything that he would call rapids between there and Lees Ferry. (R. 4646.)

He describes rapids as where there is white water, rocks, and stuff that makes the water foam and boil, and one can't tell where the rocks are. He recalls a little rapid, or riffle, at Aztec Creek, but didn't touch bottom going across there. He does not remember a place in the river near Lake Canyon where there is a rock ledge. It is swift water at that point, and he doesn't recall any such a ledge at any place on the river, and he did not touch bottom there. He remembers a place called Trachyte Rapid, just below Hite, but there is no rapid there, just a little swell in the river; nothing that he would call a rapid. (R. 4647.) All the time he was on the river he never encountered any sand waves. (R. 4648.)

Further Examination (R., Vol. 26, p. 4648):

He took supplies with Mr. Wimmer down to Rock Creek, and came back by boat with a two-horsepower Evinrude motor.

They came back on power from Rock Creek to Hall's Crossing. (R. 4648.)

Redirect Examination (R., Vol. 26, p. 4648):

He used nothing in there except the two-horse power motor boat. (R. 4648.)

Recross-Examination (R., Vol. 26, p. 4649):

At the present time he is working in the Rio Grande Railroad Shops, at Greenriver, Utah. (R. 4649.)

MRS. H. T. HOWLAND

For Defendant

(Record, Vol. 26, pp. 4651-4653)

She is the wife of H. T. Howland, who has testified, and she lived at Greenriver before she was married, for a short time. She went there in 1890, and that year took a trip down to Valentine Bottoms with her brother, Joe Ross.

The purpose of the trip was to bring out Mr. and Mrs. Valentine and their daughter. They went down in a row boat. (R. 4651.)

There was just one boat, and in the party coming up there were her brother, Mr. and Mrs. Valentine, and their daughter. She doesn't recall any difficulties in the way of sand-bars going down, and she couldn't say coming back, as she didn't pay much attention. She recalls taking the trip with her husband and family in 1910, from Greenriver to Indian Creek, and her recollection of the trip is substantially the same as her son's and husband's. Her husband and son were both on the stand. (R. 4652-4653.)

GEORGE H. FRANZ

For Defendant

(Record Vol. 36, pp. 4653-4680.)

He resides at Greenriver, Utah, and lived there for twenty years. His business is that of a truck contractor, freighting. (R. 4653.)

In 1921 he made a trip on the Green River down to the junction. Prior to that time he had not taken any trips on the river, except to cross the river in a boat from town.

He had never operated a boat on the river prior to that time, nor had he been on the river at a point below the San Rafael River. He doesn't know who was on the party on the trip to the junction, although there was a geologist by the name of Max Ball along. (R. 4654.) This geologist was associated with oil interests, but he knows it was not the Marlin Company; it might have been the Dutch Shell. He understood that he was in the country to study the oil geology, and he was employed to go down with the party. They secured a boat from Captain Yokey, but he doesn't know whether it had a name or not. It was a flat bottom power boat, about twenty-four feet long. He doesn't know what beam it had. (R. 4655.) He would judge it was five or six feet wide. He believes there were eight in the party, including himself. He was employed to take them down to the junction, and, as far as he was aware, none of the members of the party had been down the river before.

He had never operated a motor boat before this time. He was running the engine for them, and he believes all of them acted as pilots on the trip. The engine, as he remembers, was about a six-horse-power single-cylinder Marine engine. (R. 4656.) When they started out it was a wreck. They started on the journey in the late summer or early fall. He doesn't remember what month it was, but it was low water. He didn't have any difficulties on the trip, either going up or coming down. Going down he hit on a sand bar, but didn't have any trouble coming back. They were stuck on the sand bar for four or five minutes. He didn't have any trouble keeping in the channel, and the water was deep enough to get along. He doesn't remember who was in the party coming back, besides Andy Wimmer. He believes that Andy Wimmer went down with him, also; the geologists didn't come back; they went to Moab. (R. 4656–4657.) They had a boat come down from Moab and get them at the junction. When he left Greenriver he knew that his employment was only to be to the junction, and that the party was going up the river by other arrangements. They were met with a power boat, a little smaller than the one he had; maybe an eighteen or twenty foot boat. Coming back upstream he didn't have any trouble or difficulty in navigation, and left the boat at Little Valley, where he took it. Little Valley is maybe four or five miles south of Greenriver. They started at this point. (R. 4658.)

The boat was tied up at Little Valley when he went down to get it, and he left it in the same place. On the way down the party stopped to examine the country several times. He couldn't say for sure, but possibly they were five or six days on the downstream trip. He believes the biggest part of the time was spent landing and looking around. It took him two and a half days to come from the junction up to Little Valley.

He is also acquainted with the country around the Henry Mountains. (R. 4659.)

He has been down in the Henry Mountains quite a lot; he couldn't say how much. He has been freighting in from Hanksville and Greenriver, down to the Henry Mountains, and has been visiting property down there, although he hasn't been personally interested in any mining properties. He has been looking over the showings in different places down there. (R. 4661.)

On one occasion he freighted boats to the San Juan River. He believes that it was in 1921 that he hauled boats and supplies between Greenriver, Utah, and Bluff, Utah. The boats were put in the river just below Bluff. Part of the supplies were left in the boats, and the rest were taken to Goodrich. When he left the boats they were being loaded with supplies, but they were not through being loaded. He took the balance of supplies and unloaded them at Goodrich. This was for the government party which employed Mr. Blake. (R. 4667.)

Cross-Examination (R., Vol. 26, pp. 4668–4676):

He doesn't know whether it was the Trimble or the Chenoweth party, but it was either Chenoweth or Trimble with whom he made the contract.

He can't recall whom he made the trip down the [Green] river for; has a hazy recollection that it was for an oil company. Max Ball was the head of the party. (R. 4670.) He doesn't recall any of the other people who were on the trip, but he remembers making the trip, and that is about all. He only remembers striking one sand bar; if there had been trouble he would naturally remember it. He believes Mr. Wimmer was with them, but he couldn't be sure. He is speaking of Andy Wimmer; he knows Tom Wimmer was not with them. (R. 4671.) He believes Andy was along, but he is not certain of that. He ran the engine and steered the boat, and Mr. Wimmer was along to help. He doesn't believe Mr. Wimmer helped steer the boat. He doesn't believe it would take over one to steer, and he got along pretty well on it. (R. 4672.) He has been freighting down there ever since 1918, he believes, but never transported any freight on the river any more than the one trip down there.

He has transported freight to Moab and to Bluff, but never used the river, as there wasn't any water where he wanted to go. While he has wanted to go to Moab, and there is water there, there was also a highway between Greenriver and Moab, which is

about fifty miles long. He never was around that far on the river. He never investigated the possibility of using the river for freighting; was never interested.

He gets from fifty to sixty cents per hundred for transporting freight from Greenriver to Moab. He has never transported any freight down to Hite, but has to Hanksville. The price he gets depends upon the time of year. Even in the summer, one month he might do it for two dollars, and the next month it might be worth three dollars a hundred, by truck. (R. 4673–4675.) He has hauled to Hanksville for one dollar and fifty cents in the wintertime, and has got as high as two dollars and fifty cents a hundred different times a year, winter and summer. The distance is about sixty-two or sixty-three miles. All of the freighting has been by truck, and he gets about two dollars and fifty cents, or two dollars and seventy-five cents a hundred, from Greenriver to Bluff, or if he is taking a lighter load, he doesn't go by the hundred; he makes it by the trip. The minimum weight of the rates he has given would be five, six, or eight tons. (R. 4675–4676.)

Redirect Examination (R. Vol. 26, pp. 4676–4678):

He has hauled freight from Greenriver to Circle Cliff, a distance of one hundred and twenty-five miles, and received four dollars and twenty-six

cents a hundred. Circle Cliff is just west of the Henry Mountains.

He has hauled freight from Greenriver to Flat Tops, a distance of sixty miles, for one dollar and seventy-five cents, and from Greenriver to Horseshoe Canyon, fifty miles south of Greenriver, Utah, for one dollar and fifty cents a hundred. (R. 4676-4677-4678.)

Recross-Examination (R. Vol. 26, pp. 4678-4680):

The reason that the rate from Greenriver to Moab is so much cheaper than the other is because the freighting was done on a highway. He believes it is two hundred and sixty or two hundred and seventy miles to Bluff on the highway. He said he had no knowledge as to whether anyone who was on the trip he made in 1921 down the Green River had ever been on the river before, and as far as Andy Wimmer was concerned, he couldn't say as to whether he had been on the river before or not. (R. 4678-4679.)

He doesn't remember whether Andy Wimmer was on the trip going down, or whether he went to Moab, and came down and went back with him. He doesn't know which way he did go, but he believes he was along on that trip, and came back with him, but he wouldn't be sure.

He uses Whites and Morland Six Ton Capacity Trucks, and he figures the running time from Greenriver to Moab as two hours. He usually

makes it in that time, unless he has some mishap to his truck. (R. 4680.)

GUY STERLING

For Defendant

(Record, Vol. 26, pp. 4681–4695)

He has lived in Salt Lake City, Utah, since 1899. He is a civil and mining engineer by profession, and graduated from Cornell in 1887.

About 1908 he had occasion to go to the town of Greenriver, Utah, and to take a trip on the Green River. (R. 4681.)

On this trip he went down to the junction of the Green River and the Colorado River, and on down to the head of Cataract Canyon, and came back up the river. Going down he used a gasoline driven boat, about thirty feet long, about five feet wide in the middle, and two and one-half feet deep. It was driven by a propeller, the lower half of which under ordinary conditions was about a foot and one-half below the surface of the water.

The boat belonged to Milton Oppenheimer, who lived in Elgin, and he employed Oppenheimer to take him down and back with that boat. There were just the two of them in the party, and the purpose of the trip was to make a survey of a dam site, as he had located a tentative dam site down below the junction of the Green and the Colorado Rivers. He was also to examine the river, with regard to its navigability, in connection with hauling freight and heavy machinery down the river

to the dam site where the power house was to be built. (R. 4682.)

He started from Elgin, which is on the east side or the opposite bank of the river from Greenriver, Utah. Elgin is quite a town. He started on this trip on May twenty-seventh, and got back on June 26, 1908. The first night he got down to what was called Tenmile, about forty-two miles below Elgin, as he remembers. The next night he camped at Barrier Creek; and the next forenoon he reached the bottom, at the head of Cataract Canyon, or as far as he wanted to go. (R. 4683.) He stayed there three or four days, as he remembers, and then came back. He believes they were two and a half days coming back, and had reached a point about fifteen miles below Greenriver, or Elgin, when the engine broke. He doesn't know what was broken, but Oppenheimer said he would have to go to Greenriver, and get his big boat. They rowed over to the shore, and he camped there that night, while Oppenheimer walked to Greenriver, and came down the next day with a stern-wheel boat. To the best of his recollection, the boat was about twelve or fourteen feet wide, and about thirty or thirty-five feet long. The stern wheel was about six or seven feet in diameter, and was driven by a steam engine, as he remembers, and drew about a foot and a quarter of water. The broken boat had all their equipment in it, and they tied it to the rear of the stern-wheel boat, and went right up to Greenriver; left

at nine o'clock and reached Greenriver at two o'clock in the afternoon. (R. 4684–4685.) In going down stream he doesn't remember any trouble of any kind; they sailed right along, and there was a channel that the main stream of the river followed. The river is very crooked, and the channel would have to cross from one side to the other. But if they followed that channel there was no trouble in getting good depths all the way down. If they did not follow the channel, and used poor judgment, it was easy to get into shallow water. He says this in reference to the river below the mouth of the San Rafael River. (R. 4685.) On the up journey, for the same reason, he believes there was no occasion to get on bars, if good judgment was used and they followed the main channel of the river. The trip was not delayed from any conditions they found on the river; bars or rapid water. He had made one other trip before this, in the same gasoline driven boat, but didn't spend so much time in making investigations.

He believes it took them two and one-half days to go down. (R. 4686.) It took about three days to make the return journey, barring the delay from breaking the engine on the second trip.

On the first trip he doesn't remember any trouble at all, except that in crossing the river they would sometimes have to watch to keep in the deep channel. The first trip, he believes, was made in July of 1907, although he is not absolutely sure of this. (R. 4686–4687.)

Cross-Examination R., Vol. 26, pp. 4687-4694):

The stage of water was probably a little higher when he went down in 1908, as it would undoubtedly be higher in the first part of May than it would be in the middle of July of any year, ordinarily speaking. He can't say anything in regard to his recollection; and in making that answer he is frank in stating that he is going on what he knows in regard to the discharge of the stream. It would be simply a guess, but he would say it was probably about six thousand second-feet when he started from Greenriver on his first trip. (R. 4687–4688.)

He has been raised on water, and has traveled a great deal on boats all his life; his main practice in civil engineering has been hydraulic engineering. He has just formed some ideas of stream flow. His estimate on stream flow would be based on his general knowledge of the flow of the Green River, from studying the records of the river. He could only make an estimate of the flow in second-feet of the river when he started on his second trip, but he is willing to make the estimate right out loud, so everyone can hear it.

The river averages about six hundred feet in width. The quieter part of the river is quite shallow; maybe only a foot or so deep. The rest of the river would be two or three, four, five or six feet deep. This would be where the main flow of the

river was. The average velocity, he noticed at the time he made the trip, was about three feet in the channel, in the quieter parts of the river. Sometimes the water in the rest of the river would be absolutely flowing up stream, and sometimes would be perfectly quiet.

It was really difficult to make an estimate without an actual measurement, but he believes that six thousand feet is a fair estimate, and not an overestimate of the amount of water that was flowing down the river about the first of June, 1908. He would like to emphasize the fact that he doesn't believe it was an overestimate. If anything it was probably a little under, although it was right at the low year. (R. 4690.)

Mr. Blackmar:

Q. That was the time you started on May 27th, wasn't it?

A. About then; yes.

Q. You had fourteen thousand three hundred feet on that day?

The WITNESS. I would like to ask, does it give the flow there for the 27th of May fourteen thousand feet in 1908?

Mr. BLACKMAR. The 27th you had twelve thousand five hundred; the 28th, thirteen thousand seven hundred; the 29th, fourteen thousand three hundred; on the 30th and the 31st, fourteen thousand.

By Mr. BLACKMAR:

Q. What date did you return?

A. June 6th; of course it was higher then.

Q. You say it was higher?

A. Yes; I think so.

Q. It was thirteen thousand four hundred.

A. As I said, I just had to guess at it.

Q. On the day previous to that it was eleven thousand four hundred and twenty. (R. 4690–4691.)

His previous trip was in July, 1907. (R. 4691.)

Q. About what time of July, the first or the last part of July, was it the first half or the last half?

A. Probably the latter part of the month; I would say about the 25th, somewheres along there.

Q. On the 25th you had twenty thousand, three hundred and eighty.

A. Second-feet?

Q. Yes.

A. That is a mistake.

Q. On the last day of July you had nineteen thousand.

A. May I look at that?

Mr. BLACKMAR. Sure.

The SPECIAL MASTER. I don't think in the middle of this trial we can test the accuracy of these stream gauges. That is a question for argument.

Mr. FARNSWORTH. Better tell him the story of the compilation of that, too, so he will better understand just what it reflects.

Mr. BLACKMAR. This is the published record.

The WITNESS. According to that, that is what it gives; but that is very, very large for that time of year.

Mr. BLACKMAR. So we will have it in the record, the exhibit to which I have been referring is Compl. Exhibit 94, stream flow record for the year 1907 and 1908. (R. 4692.)

The WITNESS. 1908 is the year I was talking about.

He believes Mr. Oppenheimer ran the engine and steered the boat, and he [Sterling], being up in front. When there was any occasion he gave Oppenheimer directions. The occasion for his giving the directions would be that they might have a tendency to run on a sand bar that had been built out from the bank, and he would tell him to move to one side or the other to avoid it. To that extent he assisted in the operation of the boat.

When he got back he got off at the town of Elgin, and there was a hotel in Elgin when he was there. (R. 4693–4694.)

Redirect Examination (R., Vol. pp. 4694–4695):

There was a hotel there, and from his recollection it seemed to be as much of a town and as important as Greenriver. There were fruit farms, and so forth, there.

This project of a dam site was one he started himself as a hydraulic engineer, and took it up subsequently with J. G. White & Company, of New York City. (R. 4694–4695.)

JESSE M. BRANSON

For Defendant

(Record, Vol. 27, pp. 4709-4732)

He resides at Beaver, Utah, and at the present time is engaged in the business of sawing wood. He is fifty-two years old. Both he and his father were at one time engaged in the sawmill and lumber business on the La Sal Mountains in Grand County, Utah. During the period of their operations they supplied the Moab Country with lumber and the Colorado River was used in delivering the lumber to Moab from the mouth of Castle Creek to the ferryboat at Moab. The operations were first started in 1897 and 1898. (R. 4709–4710.) He again operated sawmills and used the Colorado River in carrying lumber to Moab in 1902 and continued to operate and use the river each year until 1909. In the last period this mill was located on Fisher Point on the La Sal Mountains. (R. 4711.) The one he operated in 1897 and 1898 was located on Castle Creek. The mill was located twenty-two miles from the river and the lumber was hauled by team to the mouth of Castle Creek and was then rafted down the Colorado River to Moab. (R. 4711–4712.)

The size of the rafts depended on the size of the orders for the lumber they were to deliver, but it would be about sixteen by sixty-four feet and the amount of board feet would be from ten to fifteen thousand for the raft. He believes there were

about ten such rafts taken down the river a year; sometimes more and sometimes less. He personally went on these rafts and helped take them down. (R. 4713.) There would ordinarily be two men to a raft and on the occasion that he was on the raft there were two men on the raft in front and one on the back end. This was a timber raft. The biggest of these rafts were about twenty-six-thousand. During the ten-year period the river was used anywhere from June to December. Not all of the lumber he delivered to Moab was rafted down the river. (R. 4714.) Sometimes they would take a load down the bank and sometimes over Wilson Mesa to Moab by wagon and then bring back supplies. At times the wagon would go for supplies and would not take any lumber down and at times they would send lumber to Moab in a wagon when there was just a small bill of lumber to be delivered, not enough to run a raft. Only a small proportion was taken down the river to Moab by other means than rafting it down the Colorado River. (R. 4715.) The rafting was easier and cheaper than any other way because two men could run the ten thousand feet of lumber in two days on a raft and it would take six or seven horse teams and six or seven men to transport the same amount overland.

The time it would take to get their raft down the river from the point it first was made depended on

the stage of water and the wind conditions. (R. 4716.)

During the months he was rafting there he believes that it would consume one day for the journey. (R. 4716.) When the water was low, it took more time.

The difficulties they encountered in rafting were sometimes a submerged rock, but the biggest difficulty was with head winds. At one time he lost part of one raft, but aside from that occasion the rafts all got through. On this one raft that they lost there were somewhere around twelve thousand feet of lumber and they lost about three thousand feet. (R. 4717.)

He has been from Castle Creek clear through to Moab with a rowboat and on other occasions has been down as far as the Big Bend. The occasion for making these trips was to look after cattle he had on the river bottom. They had cattle on the river bottom about six miles below Castle Creek. (R. 4718.) He never had to go in more than a mile and a half from the river to see the cattle as there were canyon walls that confined them there. When they went back up the river they would take their boats up with them.

He doesn't remember any other people that went up and down that section of the Colorado River between Castle Creek and Moab.

On the occasion that he went to Moab it was just for a pleasure trip. When he went down to Moab

he would go down just to see the town. (R. 4719–4720.)

There is some swift water and riffles between Castle Creek and Moab and he would get his boat back up the riffle by towing it along the bank with a towline. At the Narrows he would have to tow for about a quarter of a mile, but he could do so without wading the stream. He had some brothers who would go out with him on these trips. (R. 4720.)

The shallowest he ever saw the river on the Nigger Bill Riffle would be waist high on a six-foot man. (R. 4721.)

Cross-examination (Vol. 27, pp. 4721–4732):

The lumber that he cut was not all on the public domain. The first season, 1897 and 1898, was cut on government land and he believes he was nineteen years old. In 1902 they cut wood partly on the public domain. (R. 4721.) Between 1903 and 1909 they cut some timber on their own land as they bought some, a section of timber, from the State of Utah, just one section, and outside of this one section all of the timber cutting was on land that belonged to the United States, that is, during the rafting operations. (R. 4722.)

From 1894 until the fall of 1897 he was operating, but wasn't close enough to use the river. In 1897 he sold lumber at Paradox, Colorado, to the Cashin Mine. About seventy-five per cent of the lumber went to the Cashin Mine and twenty-five per

cent to Moab. In 1903 he sold lumber to other places besides Moab but practically all of the product went to Moab, and practically all to Moab in 1904. This same thing continued until 1908. (R. 4724–4725.) Sold some lumber to the Cashin Mine after 1907. Sold it in the Moab section, Grand and San Juan counties, where we sold most all of it.

Sent lumber in San Juan County to the south end of the La Sal mountains, Big Indian Mining Company got some, Indian Creek Cattle Company got some, on the south end of the mountains. On that end of the mountain they took quite a lot. He can not state exactly what amount they got when they were on that end of the mountain. It was as much as twenty-five per cent. (R. 4725–4726.) This was about 1900.

When he was rafting the lumber was sold in the Grand County District wherever it was needed. (R. 4726.)

The first mill he had was a portable mill with about five thousand feet capacity per day and the next mill he got could get out thirty thousand a day with a full crew. He got this mill about 1905 or 1906. The timber cut was yellow pine and white spruce.

In taking the rafts down he never had any difficulty in getting stuck on the riffles but would get stuck on blind and submerged rocks. (R. 4727.) He hit these rocks just once in a while at all stages of the river but it wasn't a common occurrence to

get stuck. He never had any trouble in getting stuck in the mud or on sand bars but he did have difficulty by getting the mud in between the boards which would make the lumber soggy and heavy; sink the raft—the raft would sink—draw more water than it would otherwise. (R. 4728.) These were not log rafts, they were lumber rafts and the effect of the mud was just to weigh them down in the water; make them sink deeper and run slower. He did not use any power on the rafts; they would just float down and he never had to tow them. (R. 4730.)

The time he lost part of the raft he ran onto a submerged rock and tore up part of it. He wasn't on the raft when this happened; his father and brother were there.

In bringing rafts down the river in the winter-time he never had any trouble with ice and after they would get the rafts into Moab they would ride back up the river with a team. (R. 4729–4730.) In going back up the river with teams and wagon they would sometimes go up the river and sometimes over the mesa and would sometimes walk back if there wasn't a team handy. It was about forty-two miles from Moab to his camp by the road.

In bringing the raft down it was sometimes necessary to get into the water to shake the rafts loose from a rock. (R. 4731–4732.)

THOMAS G. WIMMER

For Defendant

(Record, vol. 27, pp. 4732–4861)

(Record vol. 29, pp. 5188–5189)

He is sixty-two years old and at the present time resides in San Diego, California. (R. 4732.) His present business is ranching and stock raising and at one time he lived in Greenriver, Utah. He first moved there about 1900 and was engaged in the sheep business and later had a ranch about eight miles up the river from Greenriver, Utah. He lived on this ranch for a while and then moved into the town of Greenriver, about 1904 or 1905.

He has done boating on the Green River. (R. 4733.) When he was at the upper ranch he had a small rowboat but after living there and moving to Greenriver, he did not have any boating experience until he bought a ranch at the mouth of the San Rafael River, but he made trips with Mr. Wolverton before he got a boat of his own.

He recalls a boat owned by Mr. Wolverton called the *Wilmont,* and he took trips in this boat while he was living at Greenriver, Utah. (R. 4734.) These were just short trips.

After he bought his ranch at the mouth of the San Rafael he had Mr. Wolverton make him a boat that was called the *Marguerite.* This boat was thirty-three feet long and about seven or eight feet wide and did not draw very much water empty. (R. 4735.) The boat was built to carry three tons. He could operate as early as March.

Before he moved to Crescent [illegible]s next river experience on either the Green or [illegible]e Colorado Rivers, he believes, was with Mr. Richa[illegible]son for the government in 1914, but after he moved to Crescent his next experience was on the lower Colorado and was with Mr. Trimble and Mr. Chenoweth [for the U. S. Geological Survey] in 1921, and he was on the lower Colorado in 1921 and again in 1922 and 1923. (R. 4740.)

He made another visit to the Green River and Moab section in 1924 with the Marlin Oil Company and made some trips that year, and he was also on the river between Greenriver and Moab in 1925.

From 1906 or 1907, the time he bought the *Marguerite,* he owned the ranch referred to as the Wimmer Ranch off and on and operated it until a company came and undertook to put water on it. (R. 4741.) After that another company came down and tried to put water on by another system of water wheels and they took out the water system that the other company put in and the wheels that replaced them weren't a success and it left him without water so he left the ranch. The ranch consisted of three hundred fifty-one acres of very fertile soil.

He made trips from Greenriver to the ranch and back in the *Marguerite,* as that is what it was built for and he would make trips in the spring from the time there wasn't any ice up to fall. He doesn't recall whether he ever made a trip in December or not, but recalls that when he brought the govern-

ment crew out in 1914, under Mr. Richardson, it was about Thanksgiving. (R. 4742–4743.) Wolverton had a black line on it that would show a foot draft. When he put on more than three tons the boat would pretty near sink. There would only be about three inches of the three foot sides sticking out and on these occasions it would be in excess of two and one-half foot draft. (R. 4736.) As originally constructed the boat had a stern wheel, a propeller at another time, side and stern wheels at another time. The diameter of the first wheel was about seven feet, as he remembers it, and was propelled by a gas engine. He bought this boat in either 1906 or 1907 and used it on the river, he believes, the last trip being in 1915.

He was in the general hauling and delivery business at the town of Greenriver, he believes about 1910, and had an advertisement of his business printed. (R. 4737.) While he was in this business at Greenriver he solicited river carriage and engaged in that business.

At one time he went from Greenriver, Utah, to Crescent, Utah, a distance of about twenty-five miles by the railroad and a little farther by wagon or automobile. (R. 4738.) Crescent is off of the river and on the railroad. While there he hauled in the material for the Big Indian Copper Company. His two daughters took up homesteads at Crescent. While he was there N. K. Parsons shipped some cattle in and he had general charge of them. (R. 4739.)

He has run the *Marguerite* every time he has wanted to, unless there was ice on the river; he does not believe there was any during that time. (R. 4743.) He believes as a minimum he has made fifty round trips from Greenriver to his ranch during the period from the time he first built the boat to 1915. He has been around to Moab with the *Marguerite,* his first trip to Moab being about Thanksgiving day in 1909. On this occasion he took a party of business men, some twenty-five Salt Lake boosters. He was in the courtroom and heard a witness speak of that trip, a Mr. Howland who was a member of the crew. (R. 4744.)

Aside from the hauling he did for the government in 1914 he recalls three other trips he has made to the junction, although he might have taken more.

He doesn't remember the year that he took a trip with Mr. Richardson but he remembers a trip he took with some engineers in 1915. (R. 4744–4745.) Both the Richardson trip and the one with the engineers were for pay. He had a government contract in 1914 to haul freight on the river and during this time he made about eight or twelve round trips. (R. 4746.)

He can not give an approximation of the tonnage that was hauled, as his son and Mr. Gregory did most of that, and he wasn't there when the boats were loaded, and they would say, "Well, we probably had on eight or ten ton." (R. 4747.) On the occasions that he saw the boat loaded he would say

there were ten tons on the scow, not on the *Marguerite*. (R. 4747.) The *Marguerite* would start from Greenriver and return to that place and the catamaran scows were left at his ranch when he came back up the river.

There is a fine traction engine road that was built for the manganese claims years ago. It was built before he bought the ranch and comes from Floy, Utah, to the Riverside Camp and he hauled the coal from Floy, a station on the Rio Grande Railroad that is sixteen miles from his ranch. It would be stored there for a while and then the boys would pick it up. (R. 4748–4749.) He hauled down a railroad car of coal, but doesn't remember what size car and couldn't say whether it was less than thirty tons or not. (R. 4749.)

He believes there was one round trip made down to the government party without a load of coal or supplies.

He believes his son took Mr. Richardson on one trip on the *Marguerite* and at another time when they did not take loads he went part of the way down to get a party coming back. He doesn't believe he went clear to the junction.

While he was operating the *Marguerite* on the river he made other trips from Greenriver down below his ranch but not clear to the junction. He used to go down there and take his family for a little trip to the mouth of Tenmile. He doesn't know how many times he went, but he went when-

ever he wanted to and he did not make these trips for compensation. He made other trips down the river a considerable distance and received compensation for them. One was when Mr. Oppenheimer had two people, engineers, down there and they wanted to come out. He went down about seventy-five miles. Of course, there were the trips he made to Moab but he doesn't recall any more right now, when he went down the river, but not as far as the junction. (R. 4750–4751.)

In 1924 he made a round trip to Moab. This was in a rowboat with an Evinrude motor and he went from Greenriver to Moab and returned. He made two and one-half round trips to Moab. Two, he believed, in 1924 and one in 1925. These trips were for compensation.

His motor was four horsepower. The first trip was made with two geologists for the Marlin Oil Company. He made two trips for this same company and they were both past midsummer. (R. 4751–4752.) On the last trip the water was very low. He got back just at Thanksgiving time. On this trip the president of the Marlin Oil Company accompanied him.

The power boats that he knows of being operated on the Green River were the *Cliff Dweller,* sometimes known as the *City of Moab,* the *Navajo,* and the *Wilmont* operated by Wolverton. There were two Oppenheimer boats, one a propeller and the other a stern-wheel boat. One of these was called

Paddy Ross. Mr. Yokey bought about three that he saw; Mr. Ladd had one; Mr. Blake had one; Mr. G. W. Shores had one, and so did Mr. George Beebe. Mr. Shaw and Mr. A. I. Anderson also had boats. They were all power boats and in addition there were a good many rowboats. Nearly all the ranches had to have a rowboat to get back and forth across the river. In the early days there was no way to cross except with a ferry or by walking the railroad track. (R. 4753–4754.) He has never had any experience with nonpower boats up and down the river.

He was on the lower Colorado in 1915. He went on the river at Hite and down to Lees Ferry with LaRue and Richardson. This was in a rowboat.

In his 1921 experience on the lower Colorado his supplies came to the river at Halls Crossing and he operated a boat on the river in the fall of 1921. (R. 4754–4755.)

He had a rowboat with an Evinrude motor and he believes he went thirty miles from Halls Crossing. This was in connection with the Chenoweth Expedition and Mr. Lint was along part of the time. The motor on this boat was two horsepower and he probably went up above Bull Frog Rapids twelve to fifteen times. In going over Bull Frog Rapids he would have to have his helper use the oars a little bit but did not have to use a line or get out and push. This was about the last of Au-

gust or the first of September and he was there until late in the fall. (R. 4756–4757.)

He went above Halls Crossing to meet the Chenoweth party about thirty miles and when he met Chenoweth he doesn't believe he had any supplies with him but he delivered supplies upstream from Halls Crossing. (R. 4757.). He doesn't know how far upstream he went with supplies but he went over Bull Frog Rapid and he also made trips in delivering them below Halls Crossing. After he got on the river with supplies he went to the San Juan River to get the Trimble Party. The boat was very heavily loaded. There were three of them and their bedding. The bedding weighed better than one hundred pounds and the men weighed better than five hundred. They had six or seven hundred pounds of grub. (R. 4758.) He did not have any difficulty on this trip but he got an awfully bad scare when he went down what is known as Whirlpool Rapids. There is just a little swift water at the bottom with a whirlpool. He took on a little water there and the motor kicked them out.

He made other trips to points distant from Halls Crossing downstream. On one he went down to the Huff Party with supplies. This party was at Rock Creek, he believes. (R. 4759.) He did not load the boat so heavily on this trip down, probably six or seven hundred pounds all told, and he only had one helper. With this load, the boat would draw better than a foot of water. On this trip to

the San Juan, there was very little of the boat that stuck up out of the water. It had regular rowboat sides and they were maybe twenty inches [high]. On that trip the draft was fifteen or sixteen inches, he would say. (R. 4759–4760.)

He made a round trip from Halls Crossing to Escalante after the Chenoweth party arrived. After they started to move down the river from Halls Crossing they had to leave part of the load and he went back later and got it and took it down to camp. In the fall of 1921 he made three trips down the river from Halls Crossing and three trips back to this point. He made a number of short trips while he was waiting for the Chenoweth party. Real late in the fall he met the big California Edison Boat and it was in trouble on that occasion. (R. 4760–4761.) It couldn't get up the river with its load. The boat was alright but it had a very small stern wheel in it and the fellow that had the boat said he couldn't get the supplies up; he was supplying a party that had worked upstream from Lees Ferry. He had been supplying the three parties coming downstream with his boat. The man with the California Edison Boat asked Mr. Chenoweth to send him back and he went back and took the supplies up. (R. 4762.)

The place where he met the California Edison Boat wasn't very far above Lees Ferry. He doesn't know just where, but he believes it was up above Warm Creek.

He took the supplies up to the camp and stayed there about two weeks and he saw Bert Loper at that camp. He also saw Loper operating his [Wimmer's] boat up the river. (R. 4762–4763.) He did not see him have any trouble and as far as he knows Loper had never run a motor boat before. Loper brought down a nice load of wood, which he [Wimmer] unloaded. He found a deer in the bottom of the boat. (R. 4764.) He had known Mr. Loper for several years before this and had never known of Loper operating a motor boat.

In 1922 he went from Los Angeles to Lees Ferry and on up to Halls Crossing with four boats. Three of the boats were equipped with three horsepower Evinrude motors and Mr. Freeman had a motor but he doesn't know what kind it was. There were six men on the upstream trip and coming back there were sixteen, including the crew. They had some trouble going up past Aztec Canyon as they did not have power sufficient to get up the current with two boats because before they got there two of the engines had gone bad and these boats were put ahead of the other two and pushed up. The boats were loaded with gasoline for the round trip. (R. 4765–4766.) Supplies for the one-way trip would do them twenty days he believes. Each boat was loaded with about seven hundred pounds.

At the point where they had difficulty there was plenty of water, but they did not have power enough

to run it. He made it all right, but not without help. The boats were about sixteen or eighteen feet long and would go so slow in the swift-running water that he couldn't hold them and he let a man get out and wade it and hold the nose of the boat. He doesn't know whether or not the man rested more on the boat than he pulled it, but he guided it. (R. 4767–4768.)

He was in the court room at Los Angeles when Mr. Freeman testified and he agrees with the testimony except to the one where Freeman stated that when the two boats were lashed together, it made extra power. (R. 4768.) He did not have any more power, as he had the same engine all the time. The trouble in the engine was caused by Jones who represented himself as a boatman; he did not know anything about boats or engines and he wore his engine out by not taking care of it. Mr. Freeman wore his engine out too. (R. 4769.) He did not have any trouble with the sand getting into the engine in 1921, as he did not even take a pump and equipment with him, but just used the five-gallon can on the back of the boat, dipped the water, poured it into the can, and let it run through the engine.

The trouble that Mr. Lint testified to was not on the boat when he [Wimmer] was operating it. (R. 4769–4770.) In operating in muddy and sandy water there is a difference between an Evinrude and a larger marine motor. On his first trip down to the San Juan he had trouble with this pump. It

wore out so he put water in a can that would run by gravity, put a little piece of hose through the engine and the water would run in and out again. He continued to use this on all the lower Colorado River trip. (R. 4770–4771.) On some of the larger boats they put radiators and some had cooling pipes around the boat. The river water only circulated in the water jacket around the engine. It didn't injure the engine; it injured the pump. On the Green River he had trouble with the sand at first but he put a rotary pump on the *Marguerite* and it would handle the sand. (R. 4770–4771.) He installed this pump so that it would pump the sand right through and he had no trouble.

The water is sandy but it is a fine sand and will wear a regular suction pump out. He was not with Mr. Lint when the packing on the pump lasted about two hours. (R. 4771–4772.) He eliminated the trouble with his pump. He has never operated any boats on the river with a radiator. The Moab Garage had radiators on the two large boats and there is no reson why the boats could not have radiators on the river. (R. 4773.) He doesn't believe he ever ran an Evinrude motor prior to his 1921 trip.

In 1923 he went down the lower Colorado for the California Edison Company. He struck the Colorado at Lees Ferry and went up pretty near or to Warm Creek in the Edison Company Boat. It was the same boat that got stuck and couldn't get

up the river but they had made some change and he had been consulted by the Edison people as to the type of boat and the type of paddle wheel to use. (R. 4774.) They had changed the forty horsepower engine and had put in a secondhand Ford Engine. The wheel had been raised from a four-foot to an eight-foot wheel. He doesn't know the horsepower of the engine but it was a regular model "T" Ford Engine. (R. 4775.) In addition to putting on the eight-foot paddle wheel he had spaced the paddles a great deal farther apart. (R. 4776.) For a period of about ten years he had had experience with paddle wheels on power boats. (R. 4777.) He experimented with different types and to get a paddle wheel that wouldn't slip through the water it was necessary that it be large enough to hold enough of the water. If the paddles are too close the water doesn't get time to run in between them because the wheel runs too fast. (R. 4778.) The main thing in a paddle wheel is to not have two paddles in the water at once.

He has made a study during his experience on the river of placing and position of his load in order to operate with the slightest possible draft. When he was carrying the heavy loads for the government in 1914 down to the junction he would push the scow ahead. (R. 4779.) This was done in order to steer it and the load was on the scow entirely away from the power boat.

You take the wheel, for instance, for any reason you had to work it hard, it will pull a certain amount of water out from under the power boat. If you have got sufficient space of the water—no load much in your power boat, it won't sink under those conditions so bad as if it was directly on the boat; that is, the weight on it, it is more buoyant, allows the water to run underneath, gives you a better power; the boat that has got the load on is so far away it has no effect on what the wheel draws out from under the other boat. Load it a foot, it has a foot all the time; isn't anything to take the water out from underneath it. If it was a foot and you get into a hard pull and the stern wheel was directly behind it, it will lower it. (R. 4780.) If you get closer to the ground, it will sink in worse if you are pulling hard. In pushing the scow ahead of the *Marguerite* it would tend to keep the *Marguerite* more even. There is always a place in a river just over the top that is the hardest to get by, and as the boat comes up it loses displacement. If you have a boat ahead it prevent drawing a displacement on maybe two-thirds or one-half the boat. (R. 4781.)

From Green River to his ranch [at the mouth of San Rafael] there is swift water; what he terms rapids.

The washes that drain into the river wash in a great amount of stuff and it will narrow the river up and shift it over. There are quite a number of these rapids between his ranch and town, and

with the exception of the Brown Riffle, it is a matter of power all the rest of the way. He considers the Brown Riffle dangerous because there are two or three washes come in opposite the river. He has never had an accident there except the lack of power to go upstream, but it is really what he considers a dangerous piece of water. (R. 4782–4783.) He never failed to go up the river in the *Marguerite* and he never failed to get up any of the riffles in the *Marguerite*; only when he had engine trouble.

He has had some engine trouble going downstream and he would go and leave the *Marguerite*, but it would not be on a riffle. He had to leave it on three different occasions on account of power trouble. From his ranch up the Moab and from Moab back he had no serious trouble at all and when he started to Moab he got there when he told them he was coming. (R. 4782–4783.)

The only time he had the *Marguerite* to Moab Mr. Wolverton and Mr. Howland brought it back and he was never stuck in a sand bar with the *Marguerite*.

He knows the place called the Slide on the Colorado River and when he went through with a load of Salt Lake boosters he thought it best not to tell them they were coming to the Slide and he went up without them even knowing it was there. (R. 4783–4784.)

On the Colorado below Cataract Canyon and the lower Colorado and from there on down he had what might be called trouble just once. In going downstream with the Government Party he competed with his son to see who could run the fastest and he undertook to take a cut over and lodged on a sand bar. That was the nearest to any trouble that he knows of. He believes that he can do anything on the lower Colorado River than he can or has done on the Green River with the same boat. (R. 4785–4786.)

His observation with reference to sand bars and other bars on the Green River besides washes are that some of the washes are very large and at times floods come down which will deposit a great amount of silt and sometimes rock in the river. It usually occurs in the fall when the river is lower and they will shove the river over; make a kind of a dam and the river will wash it away again but nearly every one will create a rapid as it makes a narrow place in the river and at times they are worse than others. The rapids are worse directly after the deposit. (R. 4787–4788.) He did not say he could push the scow up over the Brown Riffle; that is one of the rapids he has just described. He has, however, taken the *Marguerite* over the riffle a number of times but never just the scow.

He has never been in Labyrinth or Stillwater Canyons and has never seen the water so low that he could not take the *Marguerite* down. He has never

seen the channel dammed across the river and has never been stopped with the *Marguerite*.

He has seen places in the Green and Colorado Rivers where the water is divided into different sections. (R. 4788–4789.)

He couldn't always tell on the first trip down which was the proper channel, but he usually considered the long way round and tried that first but sometimes he was fooled on it. This would be true where the river crosses over and would also be true in a curve. When this braided condition is in a straight stretch he never had any trouble as he was able to discover it. There is one place, he doesn't know what it is called, pretty well down to Cataract Canyon where there are a number of sand bars in a wide spread of still water, but by using sufficient caution and not running with a full head of steam he got through all right and was never stuck there. The first time he would go down, if he hadn't been down for a year, he would look around a little bit. (R. 4789–4790.) If there were three channels it would leave two sand bars exposed and all of the channels would look alike and you could enter whichever one of the channels had the real current in it. This made it easier to get upstream than downstream, for in one step you are over into deep water. The water goes over the bars, maybe two or three inches at a time, and the other current is so strong that it creates slowness and doesn't wash the bar out. In his experience on the river he has

never found a condition of this kind where there was not a channel, if he knew where to find it. (R. 4791–4792.)

He would think that a recent experience in going up and down the river would be of value in navigating it. When he first started he got either Mr. Wolverton or Mr. Ross Wheeler to run the boat and he learned from their experience until he got some of his own. It would be of value to him if he had been down the river a week previous as he would know where the channel was for sure, unless there had been a big flood and if there had, the channel would be the same as it doesn't charge, but it is the current that crosses the river. (R. 4792.)

He comes upstream, for instance, in low water through an eddy to get the easy water. (R. 4792.) In high water when a flood condition arises, the channels are just the same. In low water you have to take the same channel both up and down stream but in high water you take the back eddy water as part of it runs upstream quite a distance. In the fall of the year, September, October, and November, you have to take the same channel coming back as going down. (R. 4793.) When there would be a March rise from local snows the natural high water of the river comes up slow, but keeps crowding out and requires more space and will change the current. In the low water the current runs in the low places of the river. In high water it may hit a solid rock bank and change the current of the

river, and where there might be a sand bar they would camp on it; the current will cut across in high water and cut the bar out. (R. 4794.)

The main pathway of navigating the river is what he calls the channel and the main current of the river doesn't run in the channel only at low water. The swiftest part of the river may or may not be in the channel and the swiftest part is not always found in the channel. (R. 4795–4796.)

When he went back in 1923 for the California Edison Company the purpose of the trip was to take the officers of the company upstream past the dam site they were drilling and he went pretty near to Warm Creek. He went on that trip only as a precaution on account of the class of the company. They had a regular boatman, named Marrs, who was running the boat. He didn't have to do anything, the boat went fine and he had not trouble. They came back the same way, got stuck on no sand bars, nor did they find any water that they had difficulty with.

The large sand bars that are permanent he usually designated as islands. (R. 4797–4798.) He calls a bar one that is exposed in extremely low water, the sand of which is deposited from receding high water on the side of the canyon. He would also call it a sand bar where there are deposits of sand that are made across the stream, or just below bends. He has never heard of the term "crossing bar." Bars of the latter type just men-

tioned are the ones that at times will divide the stream into different parts.

In going down the river on his first trip in a season he is not always able to select the right channel. On occasions when he had not selected the right channel, if he wasn't running too fast and would discover that the water was going away soon enough, he would back up and go around the channel, but if he had gone down to where he was pretty solid, he sometimes hauled the boat across and would go on into the deep channel.

After the first trip at such a place, it is sometimes easier to get out and get the boat past an impediment of that kind than it is to do it with a pole. (R. 4799–4800.) That is a good deal the trouble on those trips, just what a first trip would be; they don't make so very many trips down the river during a year, and they are all, as a rule, some distance apart; in fact, the only trips he believes he took fairly close together was for the Marlin Oil Company. He did not select the wrong channel at any time in either of the Marlin Oil trips.

He has made trips downstream and then back within a day or two, two or three days, where on the down trip he got in the wrong channel in the manner described. In coming back up he did not have any difficulty in locating and passing through a good and sufficient channel; coming up the thing is self-evident; it is practically a square-shoulder sand bar; they don't get into it at all; they follow

the channel; that is, they may nose up close enough to see the water washing up, then they edge out a little and keep going around through the channel. (R. 4800–4801.)

He doesn't believe the real channel changes except in extreme low water when the channel runs from one side to the other. In high water the current will probably go the other way. The current is going with the channel in the first instance, but the strong part of it will probably cross over the other way and form an eddy where the low-water channel is and there may be a small bar from where this eddy comes down and connects with the main channel for a little way; a little pointed bar where the eddy goes in next to the bank and comes over and strikes the current of the river. If he makes it up beyond this point he has to come back, go around it and go out in the swift water. This is the only difference that he sees in the channel and is the only type of unstability that he has noticed.

What he meant when he said he was never stuck with the *Marguerite* was that he always got through. He did not mean he never hit a sand bar. (R. 4802.)

Deft.'s Ex. No. 20 is a picture taken on the Colorado and shows the engineers going down the Colorado from Halls Crossing. It also shows an obstruction on the side of the river that causes the sand bar to form on the side of the bank. (R. 4803–4804.)

He can't tell what part of the river Defendant's Exhibit No. 19 shows, but it is the scow and the *Marguerite* that was used to haul government stuff down to the junction of the rivers during the drilling. The scow was in the lower part of the picture and the *Marguerite* is behind that, tied to the bank. (R. 4803-4804.)

He believes the actual channel is the same in high as low water and he never found any time he couldn't run in low water except this little point he speaks of going upstream and connecting with the down current, and he would dodge the current going upstream. (R. 4805.) The location of the river and the channel of the river in a given year after the spring high water has subsided compared with the location of the river and the channel years before and years after, is practically the same outside of where washes come in from the side and shove it out a little.

There used to be more water wheels constructed on the Green River than there are now. He had three on his ranch and these wheels were of permanent construction. He knows of no instance where the wheels couldn't reach the water. He irrigated his ranch with these wheels for a whole season and unless drift would come down and take a paddle out they were permanent. The river hasn't changed at all at his ranch. The current turns the wheels and delivers water and he also had a pump and engine installed that didn't extend into the

river over eight or ten feet and it was a permanent installation. (R. 4806.)

He has hauled uranium ore over land from Trachyte to the railroad as far as the wagon road went. He has also hauled manganese ore from the Colorado Fuel and Iron Company deposits south of Floy. This deposit is located eight or nine miles east of Greenriver and he personally hauled manganese ore from the deposit to the railroad during the war and just before it ended. He doesn't really know just when he started or just when he quit but he was probably hauling there a couple of months just before the war ended and he delivered five or six hundred tons a month to Floy that is located on the Rio Grande Railroad. (R. 4807.) When he hauled uranium ore it was for the Standard Chemical Company and he used six horse teams and he must have worked for them for about a year steady. He has never been right at the uranium mine, but only to Trachyte Camp, which was near there, and about fifteen or twenty miles west of the Colorado River, if not a little farther than that. (R. 4808.)

He has done a considerable amount of land freighting in that section of the country. He knows what the comparative cost of land freighting per mile is, with water carrying both up and down stream on the Green River, from his own experience.

At the time of delivering stuff for the government down to the junction of the river he was also hauling for the Standard Chemical Company with teams. They are practically the same distance, about ninety-five miles to Trachyte and about one hundred miles to the junction.

The cost per ton upstream was about twenty-five cents on the river, not including depreciation or overhead. His cost per ton a mile was thirty-five cents from Trachyte to Greenriver by team, not including depreciation or overhead. (R. 4808–4809.)

On this one trip he practically hauled upstream the same as he would haul with a six-horse team from Trachyte; about three tons.

The scow might have cost two hundred dollars to build, although he doesn't know, and the boat probably cost him seven or eight hundred dollars. The horses would be worth one hundred-fifty dollars and the set of harness for two horses was worth about thirty-five dollars or a little more, and he had three chain sets. The wagon he used on the trip was worth two hundred dollars.

Downstream on the river he would haul about eight tons as against three tons coming up and he would take eight tons down a little cheaper than he could bring three up. The cost would be about the same. The depreciation on the land outfit was a great deal more. The depreciation of the boat was very little. In the dry country the depreciation

on wagon, harness, and horses is very heavy. (R. 4810–4811.)

In his experience the wagon haul is accompanied with the greater hazard. The nature of the hazards would be the Dirty Devil River where he had to ford it with the loads. The roads are always in bad shape and he could only load one thousand [pounds] to a horse. To his knowledge there is no road from Hanksville to the junction or from Green River to the junction. (R. 4811–4812.)

Cross-examination (R., Vol. 27, pp. 4812–4819):

He didn't have to get over in the water very often during the operation of his boats on the river, and doesn't know how many times; whether or not there were as many as five. (R. 4812–4813.)

By the SPECIAL MASTER:

"Q. In all these years you have been on the river you must know whether you have been five or not.

"A. I suppose maybe five, but I didn't get out in the water very often, I'll tell you that." (R. 4813.)

He never had to get in the water if he didn't want to, but he chose to get into the water to get his boats off.

Q. And did that happen frequently or infrequently?

"A. Hardly at all, you might say.

"Q. Would you say in all the time you have been on the river you have been in the water as many as twenty-five times?

"A. No, sir.

"Q. You would say somewheres beween five and twenty-five times?

"A. I would say it wasn't twenty-five." (R. 4813.)

He doesn't believe it would run anywhere near twenty-five times as he never got in the water very often to help the boat off. "If you notice in the pictures, you will notice me sitting back in the engine and letting the other fellow do that." (R. 4814.) There were not very many times that some member of the party would get out to help the boat off as he usually had a pole or something to push it back and he couldn't give an estimate as to how many times, but he believes it did occur. He doesn't believe he was ever on a sand bar to exceed thirty minutes, if that long. (R. 4814.)

When Mr. Freeman, the other two men, and himself came up from Lees Ferry to Halls Crossing he believes they were traveling eleven days altogether, but they went to the Rainbow Bridge the one day. He doesn't know how many miles it was and he hasn't much idea about it, but his judgment would be about one hundred twenty-five to one hundred fifty miles. (R. 4815.) Some days he didn't make as much as eleven miles a day and sometimes more on the trip from Lees Ferry to

Hall's Crossing. [The map shows one hundred eighteen miles.]

They had to help the boat up with oars and at one point somebody got out and had to tow. This was at Bridge Canyon, and was the only place in the whole distance up the river.

He did not keep any particular account of the hours a day they would run, as they had twenty days to make it in. (R. 4815–4816.) They were ahead of time and did not hurry but he would believe they traveled five or eight hours a day and he would suppose it was a little less than two miles an hour. He was putting in the time on the trip usually waiting for Freeman and Bill Jones and they went faster after Freeman and Jones were ahead. He couldn't say how many days they put in waiting for Freeman and Jones but they put in a good many hours. He did not put in very many days waiting because he believes the second or third day he began to push Freeman's boat. (R. 4817.)

It was after the boats were put together that they had the trouble at the one rapid at Bridge Canyon. They didn't run into a ledge of rock in Lake Canyon; they saw it but did not ground there at all, as he knew the way through.

He was never in the water at Lake Canyon and he hasn't any information as to the depth of the water there, but in low water the ledge is pretty close with just one kind of cut-out place in the end

and if you go through that you will not hit. This place is about thirty feet wide. (R. 4818–4819.) The ridge extends practically across the river excepting the cut-out place. He knows that it goes clear across the river because he could see that water go over it but couldn't see the ledge. (R. 4819.)

The propellers were hinged and in a case like that they were tipped up and they would float across. They weren't lifted up going upstream and it didn't hit. He passed there several times and he didn't always lift the motor up. If he thought there was danger of hitting he would do so and if it did hit it would tip itself up anyway. When he left it down he never did hit.

He took a trip on the *Cliff Dweller* at one time from his ranch up to Halverson's ranch, about fourteen miles. (R. 4820.) Had trouble getting up; they had a capstan; they put it around a tree; when the tree would hold it we could pull it up. (R. 4821.) He quit the boat at Halverson's as he wanted to get back to the ranch. He never took another trip on the *Cliff Dweller,* or was never employed as a boatman and never had any financial interest in it.

He doesn't believe there is a great deal of difference as far as best water is concerned either below or above Bridge Canyon between Halls Crossing and Lees Ferry. (R. 4821–4822.) In his judgment it is practically the same.

There is a rapid right at Halls Crossing and one they call Shock Rapids, but neither of them proved to be as bad as the Bridge Canyon Rapid and he ran them a time or two. He also ran the Bridge Canyon Rapid on other trips. From Bridge Canyon on down to Lees Ferry there weren't any rapids that bothered him. The water is about the same. Warm Creek comes in there and he couldn't tell the difference either in going down or coming up the river. (R. 4821–4822.) He doesn't believe it made any difference whether he was going up or down stream; the water would be the same.

The last time he saw the *Marguerite* it was tied above the Bridge at Greenriver [Utah]. He didn't sell it before he left Greenriver; just anchored it to the bank. He believes he has been back to Greenriver since he tied the *Marguerite* up. The last time he was in Greenriver was about the 23d of October, 1929, and he didn't see the *Marguerite*. He doesn't know where the boat called the *Navajo* is now, but he did not see it when he was at Greenriver the last time, nor did he see any boat on the Green River at that time. The only boat he saw was the one at the ranch. He remembers now that he did see a power boat at Greenriver the last time. It belonged to Mr. Yokey. (R. 4823–4824.) It was a steel boat and hadn't been launched yet.

He saw another boat of Mr. Yokey's that he was using for a settling tank to settle the water to put in his steam engine. Mr. Yokey identified it for

him and told him what it was but didn't tell him the name of the boat.

He went into the general hauling and livery business about 1909. (R. 4824–4825.) When he was in this business he used pack and saddle horses, boats, freight teams, an automobile, buggy, and mules. (R. 4826.)

In addition to the freight he hauled for the government on the *Marguerite* he hauled all of his own freight from Greenriver down, and outside of this he doesn't believe he hauled any other freight down the river.

Aside from the Salt Lake boosters that he hauled on the *Marguerite*, he took passengers on the Richardson trip, which was a Government Survey Trip. Mr. Richardson did not stop from time to time as he wasn't surveying. He was the head man of the Reclamation Service and went down to the junction. (R. 4827.) It took two days from the ranch and three days to get Richardson back. They had plenty of water at that time, as he recalls it.

The average round trip would be about five days because they camped nights and didn't get in days at all. (R. 4829.) The hours would depend a little on whether it is high, swift water, or low water channel, but he would say it would be about fourteen hours running time on the down trip to the Cataract on the *Marguerite*. This would include stops and would take about two days; seven hours each. It takes about one-third longer to

come upstream, depending a little on the stage of water, but his idea of it is that it would take about seven hours longer to come up.

He believes the Richardson trip was made in 1914; he also went down later that same year. He then made a round trip to Moab on the *Marguerite* that he calls a booster trip. (R. 4828–4829.)

On this trip he traveled right along after the dishes were washed and he believes there were six days from Greenriver to Moab. He didn't come back with the boat; he got out and came around. The whole party would land and camp at night and they did all their own cooking. They didn't take tents; just camped out in the open and it was very pleasant; not cold. The boat and crew came back around the river and he went back to Greenriver. (R. 4830.) He doesn't know whether they went to Thompson Springs by truck or by team but he believes they were using teams then. He went back overland to Greenriver, because he could go quicker than by boat. They went through the river to look at it and this had been accomplished. The only reason that he went on the trip at all was to see that the party got through all right and when they were through, he knew the boys could get back all right. He doesn't know how long it took him to get back to Greenriver by the way of Thompson and the railroad, as he might have walked but he doesn't believe he did. He doesn't know whether the automobile was running or not.

(R. 4831.) It did not take him more than a day. He doesn't remember how long it took the boat to get back.

He took two and one-half round trips by boat to Moab for the Marlin Oil Company and the Standard Oil; two round trips and one trip to Moab, from where he went out by automobile. It was five days from Greenriver to Moab on the Marlin trip. (R. 4832.)

He had two boats on this trip that he took as far as the junction, where he left two of the party and then took two of them to Moab, being two days going up. (R. 4833.)

The *Marguerite* at that time was still tied up at Greenriver, where they left it. (R. 4833.)

The Standard Oil trip was just a one-way trip, on which he used an outboard motorboat that belonged to them. (R. 4833.)

He had no one with him on this trip to help manage the boats. This boat did not get to Moab as it was burned up twelve or fourteen miles above the junction on the Green River. Only one side of the boat and the oars, which were lying in the bottom, were burned. He repaired the boat with a piece of canvas and went on down to the junction in it. All their bedding, grub, and supplies were also burned.

Before they left on the trip they left word that if they did not get out in a certain length of time they were to be sent for. There were boats at the Shafer Well that came down and got them. Five

of them went upstream in one outboard motor boat, except through the Slide. One man rode the boat around the Slide and the rest walked and then all rode the rest of the way to the oil well.

In 1915 when he first went down to Hite he took Mr. LaRue and Mr. Richardson with him and they expected to get Mr. Bert Loper to take them to Lees Ferry in a rowboat, but Loper wasn't there and he took them through to Lees Ferry. (R. 4834–4835.) On this trip he bought a boat at Hite.

He was next in the Glen Canyon in 1921 and he doesn't know whether the boats were from Greenriver or Richfield, but they were taken overland from one point or the other.

He was just working for wages; he had no contract and he eventually took change of freighting from Greenriver. (R. 4836.)

He didn't bring them down the river because they were afraid of the Cataracts. They were hauled overland. He has never been through Cataract Canyon.

He has never had any difficulty on the rivers on account of the sand getting in the bearings as it doesn't get in the bearings; it wears out the pump. In an Evinrude motor there is a gear that unless it is kept loaded with hard grease the water will get into the gear. He used a different engine each season he was there. (R. 4837.)

He doesn't believe the low-water channel shifts, but there will be a rearrangement of the sand bars

as they will be covered up in high water and can not be seen. When the river rises six or eight feet he would run into what he called permanent islands. He hit these islands if he got careless but he doesn't believe the low-water channel shifts. He believes the current shifts.

In making a trip on the river this year he will find the channel in the same place as it was the last year. (R. 4838.)

He also found sand bars but he doesn't believe he paid much attention to them and he doesn't know whether they were there the last year or not as they did not amount to much, but they amount to enough so that he usually lets some one else get in the water.

The signature on a statement handed to him, he thinks, looks like his, but there is one word he wants out because if he dictated that one word he was mistaken. (R. 4839.) He wants current put in instead of channels. Outside of that one word on page five, line six, of Complainant's Exhibit No. 631, he thinks the statement is all right.

(Complainant's Exhibit No. 631, the written statement of Thomas G. Wimmer, received in evidence.) (R. 4840.)

When he figured the twenty-five cents per ton-mile he used his men's wages, the gasoline and oil, and it was based on one hundred miles. He figured two men's wages at $1.50 a day and their board.

He did not keep books and it is just an estimate of what he thought it ought to be.

Part of the freight was taken from Greenriver, Utah, and part of it was taken from the ranch and he estimated the average of the trips. (R. 4841.) All of it is just an estimate. He figured it out himself. He only figured from the ranch and did not figure from Greenriver. (R. 4842.)

The supplies were all brought from Greenriver and Floy, Utah, to his ranch, either by river or team from the railroad and he figured the ton-miles on a one hundred mile basis from his ranch to the Cataract. Upstream he figured on a basis of three tons as that is what Mr. Sawyer testified. (R. 4843.) He believes he figured eight or nine tons downstream. He doesn't remember really which figure he used.

For the two men it was three dollars a day. (R. 4844.) He figured two days downstream and upstream thirty-two and one-half hours, or what Mr. Sawyer testified to. He will say the upstream trip was three days and the two men for three days would be nine dollars and he believed he allowed a dollar a day each to feed his men, both up and downstream. (R. 4845.) He would use about eighty gallons of gasoline for the round trip, although it might have been eighty-one gallons. He thought he had his figures with him but he hasn't them. He figured his gasoline at thirty cents a gallon. On the thirty-five cents a ton mile for his horses and

teams he had six horses and one driver and they would be gone twelve days and hauled three tons back. He included the grain and hay he fed the horses and the meals for the men and believes he sent twelve sacks of grain for the round trip. The grain was worth three dollars a hundred and the sacks would weigh one hundred pounds each. He paid a dollar and a half a day and board for each man. He paid them for the teams and they were in town a day getting repairs but he doesn't know whether or not he included that in his figures. The twelve days were the actual traveling time. (R. 4847.) This is an estimate but he figured it out.

There was the one driver for the twelve days, twelve sacks of grain, board for the men and hay, all of which he believes is covered in his estimate. (R. 4847-4848.)

He hauled down to Tracbyte for a period of a year and he is not sure that it wasn't longer.

In arriving at an estimate of thirty-five cents per ton mile he just took one trip and did not take over the whole period of time. (R. 4849.)

Redirect examination (R., Vol. 27, pp. 4849-4851):

He made the statement that was offered in evidence because one of the government men asked him to, but he wasn't subpoenaed by the government at that time but was subpoenaed later on. (R. 4849.)

He attended court regularly at Los Angeles under government subpoena. In this statement on top of page five where it says, "I think the channel is more discernible in medium low water than it is in right high water," and farther down he said, "We are more liable in exceedingly high water to run across a bar in the center of the stream, because of the channel going to one side or the other," the word channel should be current and what he meant by the statement is that what he calls a permanent island would get submerged in real high water and he might hit one of those submerged bars, as he was liable to get careless and not follow what he calls the channel. (R. 4850–4851.) He is now talking about the Green River, but they have permanent islands in the Colorado River in high water. He has not been down the Colorado in high water. (R. 4851.)

The reason that he would judge the islands are permanent was because there was brush and trees growing on them.

On page five of Complainant's Exhibit No. 631 where it says, "You can not depend upon boating in the winter, because the ice will form," he means that it freezes over some winters and is pretty hard boating there. (R. 4851.) He has seen some winters when it did not freeze at all; others when it froze very little and he has crossed the ice in the morning with a horse and by noon there wouldn't be any ice in the river. It is so irregular you can't

tell a thing about it and the winter navigation can not be depended on because there may be ice that would stop him. (R. 4852.) Ice comes in a continuous cold spell on the river and it might be in one month or another.

Q. At the bottom of page 5, Compl. Exh. No. 631 and continuing over to two words on the top of page 6 of the statement, you have this language:

"The feasibility of boating operations from Moab to Greenriver for commercial purposes such as the hauling of farm produce and freight is not a feasible proposition now or ever."

What do you mean by that?

A. It is thirty-five miles from the railroad over a truck road; it is about two hundred miles around to Greenriver by boat; I don't call it feasible to haul two hundred miles when you can haul it thirty-five by truck. (R. 4853.)

Further examination (R., Vol. 27, pp. 4854–4856):

There is a road from his ranch to Greenriver that connects with the road from Floy to his ranch. They connect right at Floy on the main highway, the Midland Trail, but there is no road down the bank of the river from Greenriver to his ranch. There is an old road that he used that was on what is know in that country as the Moab Mail Route and he would go out on that a ways and then to his ranch. This was a little shorter than going to Floy

but not nearly so good a road and they practically came together before they reached the ranch. (R. 4854.)

He saw sand waves at the mouth of the San Juan River when he went down with Mr. LaRue and Mr. Richarson in 1915. They are just like ocean waves and he did not pay any attention to them. They were just coming out of the San Juan and did not interfere with his boating.

He made his headquarters with the Chenoweth Party after Chenoweth got down, but he wasn't on the boat with Mr. Lint at all. (R. 4855.)

From his experience on the Green River from the San Rafael to the junction and the Colorado River from Hall's Crossing down to Warm Creek, in comparison, he believes there are more rapids on the Colorado River and as far as the navigation of the river with the boats he has used there would be practically no difference in going downstream as there is plenty of water in every case. In going upstream, he believes the current is a little stronger on the lower Colorado than from the junction of the rivers up the Green River to the mouth of the San Rafael. This comparison is based on the months that he has been there. (R. 4855–4856.)

Redirect examination (R., Vol. 27, pp. 4856–4858):

The only difference, he believes, is that more power is required. He believes there is a little more current and he knows it is a little steeper;

more cataracts as there is not a cataract from the San Rafael to the junction of the river; there is hardly a riffle in the whole distance. (R. 4856–4857.) With a boat like the *Marguerite* there would be no difference in the practicability of the navigation up and down stream on the section of the lower Colorado and on the Green River between the mouth of the San Rafael and the junction of the rivers. There is not enough difference in the two waters to make any difference with a boat like the *Marguerite*. (R. 4858.)

Recross-examination (R., Vol. 27, pp. 4859–4861):

He has been in Moab recently; he believes about the 20th [of October], 1929.

He took one of the state attorneys, Mr. Parkinson, who hired him to go over, and gave him thirty dollars for six days' wages and paid his expenses. He doesn't believe he assisted Mr. Parkinson in interviewing witnesses and was not present when they were interviewed. He was present when one witness, a friend of his, was interviewed. He did not go down to Bluff with Mr. Parkinson. (R. 4859–4860.)

He saw the boat at Moab that belongs to the Moab Garage and they were getting ready to go down the river when he saw it; at least, they said they were going; the engine wasn't running. There were two boats over there but they were just fixing up the Moab Garage boat. He doesn't know the name

of the other boat. He understood it belonged to an oil company. Both of them were just tied up at the shore and they were simply kind of cleaning the boat up and said they were going down the river. (R. 4860–4861.)

Recalled (R., Vol. 29, pp. 5188–5189).

Further examination:

The SPECIAL MASTER. It lay in my mind that you based your estimate on a five-day trip, and I noticed in your statement which you signed here, given to the government, you said the round trip took seven or eight days.

A. I will tell you why that is. The boys, when they came to town each time from my ranch, they didn't go directly back; somebody came up and reported to me on the proceeds of the trip.

The trip did take them seven or eight days, before they would make another trip, but the actual running time is about five days to the ranch. (R. 5188–5189.)

MRS. ALLIEN RUSSON

For Defendant

(Record, vol. 27, pp. 4865–4870)

She is the wife of Mr. J. S. Russon, is twenty-two years old and resides at 1145 East 4th South, Salt Lake City. She was born at Moab. (R. 4865.) During her life she has gone up and down the Colorado River at Moab several times and has seen many others.

She took a trip in a motor boat on the Colorado River in the spring of 1925 on the Moab Garage large boat. She went down to Shafer No. 1 Well and returned without experiencing any difficulties going up or down the river on that occasion. The boat was not stalled at any place.

In the fall of the same year she made a trip to the same place in a small motor boat. (R. 4865–4866.) On this trip she went with her uncle, Mr. Taylor, Mr. Harvey Lytell, and Louise Goodman. Her uncle was about twenty-two or twenty-three years old. She had never operated a motor boat before this trip. The other young lady of the party, Louise Goodman, and her uncle, who was on his vacation from the University of Michigan, were going to school. The other young man was a driller at Shafer No. 1 Well.

Mr. Lytell had made one trip in the same boat. (R. 4867.) She doesn't know this of her own knowledge; he just told her. On this trip they went down the river, she believes, fourteen miles, to the Shafer No. 1 Well. There were no others in the party except those named. Mr. Lytell piloted the boat down except for about two miles when she piloted it. Her uncle piloted the boat back. (R. 4867–4869.) They did not encounter any difficulty on that trip, did not strike any sand bars and did not have to get out of the boat and do any wading. None of the party had to get out and she has no recollection of any-

thing impeding the progress of the boat up or down. (R. 4868–4869.)

Cross-examination (R., Vol. 27, p. 4869):

She made her first trip in May, 7th; on which trip Mr. Virgil Baldwin operated the boat. She Just went for pleasure and the second trip was just a pleasure trip. (R. 4869.)

Redirect examination (R., Vol. 27, p. 4870):

The second trip was made in the first part of September, 1925. (R. 4870.)

W. F. REEDER

For Defendant

(Record vol. 27, pp. 4870–4895)

He resides at Salt Lake City and Crescent, Utah. Crescent is located about eighteen or twenty miles east of Greenriver. His occupation is that of an oil-well driller, and at present he is drilling at Crescent for the Crescent Eagle Oil Company.

He first went to Greenriver in 1921, was there about two months and then went east. (R. 4870–4871.) Later the same year he returned to the same section of the country and made his residence there for a short time in Elgin on the east bank of the river.

At the time he was in Elgin he believes there were three houses and there was no hotel at the time of his arrival. Later that year more houses were built. (R. 4872.) He couldn't tell how many

houses were constructed at Elgin after his arrival; he never counted them but there are quite a few people living there now and there is a post office but not a hotel. After he made his home in Elgin he had occasion to make trips down the Green River, his first trip being in August, 1902, he believes. (R. 4873.) This was after his return from the east.

On this trip he went down to the Cataracts in a skiff; an ordinary rowboat. It was about sixteen feet long and he believes about a four-foot beam. R. C. Wheeler went with him, the purpose of the trip being to look over the country and to prospect and they took supplies along with them. They were prospecting for mineral and looking over the land down there. (R. 4874.)

He believes they went down to the Cataracts in about two days and did not stop on the way down. They had a good stage of water, went right along and took their time coming back. They stayed at the head of the Cataracts for a day or two looking around and he doesn't remember how long it took to come back as it was on the up trip that he did the exploration work on both sides of the river; did not go far as he was just looking over the river bottoms on the trip. (R. 4875.)

He first went to Greenriver in 1901 instead of 1921. He lived at Elgin until the fall of 1906 and during which time he took other trips [on the river]. Between 1902 and 1906 he believes he took

six trips. He went down to the junction and up to Moab on the Colorado River, using the same boat that they had on the first trip, and Mr. Wheeler was with him also. This was a prospecting trip for gold and black sand and they got some colors and plenty of sand. He did not take out any gold but he shipped some samples to Mr. Scott of the Carnegie Steel Company, who sent him the results of the assays. The reason he went for the black sand was because there might be platinum in the sand; Mr. Wheeler having told him there was more black sand on the Colorado than on the Green, and they panned on both rivers. He doesn't know the content per cubic yard as there wasn't enough gold to get excited over and he did not know about the platinum until after the analysis but he did not get excited over that. From his experience he doesn't believe the beds have a sufficient gold content to warrant any exploration. (R. 4876–4877.)

He has made six other trips with rowboats besides the first trip; each trip being as far as the confluence [of the Green and Colorado Rivers], and two of them to Moab. He made a trip in a motor boat also. (R. 4878.)

On the trips clear around from Greenriver to Moab he would just tie up the boats at Moab, get supplies and go back to camp. In going upstream he would row and tow and when the wind was favorable would rig up a sail with a tarpaulin.

He is familiar with some of the rapids on the Green River, but has never been able to sail over them. He would get up over the rapid water by getting out and towing his rowboats up through the Slide. (R. 4879.)

When he made these trips he never got any supplies at any other point than Green River or Moab as there was no other place to get them. The trips were taken in August, September, October, and November.

He took a trip on the Green River in a stern-wheel motor boat belonging to Mr. Wolverton, and which he believes was named the *Wilmont*.

He started from Greenriver with Mr. Oppenheimer in a stern-wheel boat and something went wrong with the machinery just above the Wimmer ranch and in repairing it the cone gear was stripped. (R. 4879–4880.) They floated on down to Mr. Wolverton's place and had him take them to the head of the Cataracts and back. On the return journey, Wolverton brought them back as far as his place, which was just below the Wimmer ranch, and they hired a team at the Wimmer ranch. The purpose of this trip was to take some people from Indiana down the river and show them the land down there with the idea of irrigating it. There are several large bottoms in the river down there and the idea was to raise stock, raise cheap feed, and drive the stock out.

One of these places was the Townsite Bottom, and one was called the Phil Foote Bottom. (R. 4881–4882.) The Phil Foote Bottom has several hundred acres in it and he estimated the Valentine Bottom had about one thousand acres. The Townsite Bottom is quite large; the approximation would be about three or four hundred acres. Another bottom called Grassy Bottom, of which he doesn't remember the acreage, might be larger or smaller than the others. (R. 4882.) None of these trips had anything to do with a sanafarium.

He observed a large bottom below the junction and above the head of the Cataracts that is about one-half mile long and is almost that wide. The soil is the finest soil in the world; he took samples of it. He did not figure on irrigating by gravity as he expected to use a pump, but the lands are so situated that river water can be used in time. He couldn't tell the dimensions of the Wolverton boat. (R. 4882–4883.)

On the trip that Mr. Wolverton took him on, there were six in the party, and he believes it was made in either September, 1905 or 1906.

He took a trip down the river in October, 1914, for the purpose of taking moving pictures of the Cataracts, Charles Russell, being the head of the expedition, and Mr. Tadje the camera man. (R. 4884–4885.) They had a rowboat made of sheet steel; a boat designed to run the Cataracts. This was the only boat they had and they went through

Cataract Canyon and stopped at Hite. They ran all of the rapids but one and had to portage that because Russell had turned over a boat and lost the oars so they portaged down below and let the boat down with a line overland and found the oars drifting in an eddy. (R. 4885.) This boat had watertight compartments with a cock pit in the middle, a little hatch in front and one in back where they put all their provisions, bedding, and other stuff. They all had life preservers and wore them, but he did not wear a life preserver before reaching the Cataracts. He left the river at Hite.

Since the 1914 trip just described he has not made any other trips on the Green River. (R. 4885–4886.)

Their boat, he believes, loaded would draw eight inches and there is always plenty of water on the Green River for rowboats. There are sand bars that he could hit if he wasn't careful, but if he would follow the channel there is plenty of water to run a well-loaded rowboat.

Coming upstream he had to take advantage of all of the tidewater he could find, either rowing or towing. Sometimes he would run on a sand bar, push off, and have plenty of water. The situation with respect to difficulties or obstructions in boat travel from the head of the Cataracts up to Moab is about the same [as on the Green River]. (R. 4886–4887.)

He knows a place called the Slide and he had to tow up through there as it was narrow and swift water was coming through.

On the motor-boat trip that he took with Mr. Wolverton they did not encounter any difficulty; did not get hung up a single time on sand bars. Mr. Wheeler was the pilot, Mr. Wolverton ran the engine, and the rest of them were passengers.

Mr. Wheeler was the oldest man on the river. He moved there in 1884, he believes, and established a ranch, now called the Wimmer Ranch, and he has made many trips up and down the river to his knowledge. He has been with Mr. Wimmer several times.

He has never gone on any boating on the Green River in any kind of a boat where he met with any mishap. (R. 4887–4888.) The time they had the mishap with the motor boat was carelessness on the part of that particular operator, but as far as the river is concerned or any condition in the river or its bed, he was never occasioned any trouble or annoyance except the ordinary work of getting his boat up and down stream in the river and he always got where he started for. (R. 4889.)

Cross-examination (R., Vol. 27, pp. 4890–4892):

When he was on the motor boat he did not carry any poles or equipment of any kind to push off sand bars with. He has got out in the water to

push off sand bars when he has run up a little too far in an eddy, and this would happen once in a while. He is sure that on the motor-boat trip they never ran on a sand bar, and he made a perfect trip; did not strike an obstruction anywhere. Mr. Wolverton thought that this was rather an unusual thing. (R. 4890.)

He got back from Hite to Greenriver overland, and he hasn't been down around the place called Wimmer's Ranch since 1914.

He has some derricks where he is drilling around Floy or Crescent, and he drilled one well four thousand and seven feet deep, one six hundred feet, and one twelve hundred and some feet. These wells haven't been completed; the one is standing full of oil but has never been cased. It has two strings of tools in it, and they are waiting a ruling from the department so they can go back to work.

He doesn't believe the pictures that were taken on the trip with Russel and Tadje were ever shown only to just private companies. He saw them in Salt Lake City when the hearing was on the last time. Mr. Tadje showed them over at the Paramount. (R. 4891–4892.)

Redirect examination (R., Vol. 27, p. 4893):

On his exploring trips down the river he did not observe any oil structures along the Green unless possibly Dry Lakes might be a structure, but he hasn't made a study of the section so he would care to give his opinion about it. (R. 4893.)

Further examination (R., Vol. 27, pp. 4893–4894):

The six trips he took with Mr. Wheeler to the junction were made in 1902 and 1903. On the moving-picture trip in 1914 he went as a boatman.

He did not have very much boating experience in between the time he went down the river when there were six in the party and the moving-picture expedition, a period of some twelve years. He had had a lot of boating experience before he had ever seen the Green River on the Alleghany, Arkansas, Kiscambidy, the Monongahela, the Ohio, the White River, and a number of others.

He was bridge building and the type of boats used were rowboats and he has also had some experience with steamboats. (R. 4893–4894.)

Recross-examination (R., Vol. 27, p. 4895):

When he came out from Hite he came back to Greenriver overland by team. (R. 4895.)

A. L. CHAFFIN

For Defendant

(Record, vol. 28, pp. 4899–4974)

He resides at Kanesville, Utah, and is engaged in construction work, as manager of the Wonderland Irrigation Company. His full name is Arthur L. Chaffin. He is the brother of Lou Chaffin, who has been a witness in the case. He is forty-four years old. (R. 4899–4900.)

As near as he remembers he was first on the Colorado River in 1898 or 1899. He was living at Teasdale at that time, and went to the mouth of Hanson Creek, crossed the river, and went down about a mile to the Moquie Bar, where his brothers, Lou and George Chaffin, were working. He was there for about four months, going in in October or November and left in the spring. (R. 4900.)

During the time he was working on the Moquie Bar there were five of them, and they got their supplies from the mouth of Hanson Creek, and boated them down and across the river to the Moquie Bar, about a mile and a half. In transporting the supplies he used a boat about sixteen feet long and four feet wide, square built. It had no power, and was rowed, poled, and towed. They were using two teams, for which they had to haul in the necessary grain, and he believes that he made at least six trips back and forth during that time. (R. 4901–4902.) These six loads that came in were wagonloads, and two wagonloads would usually make about three boatloads. During this same period he went up to Mike Ryan's at the California Bar, a distance of about three miles, in the boat he just described. They just had the one boat, and took one trip down the river that winter, as far as Moquie Canyon, about three miles. (R. 4902.) In going upstream on these trips he would either row, pole, or tow. They were scraping the gravel into a pit and screening it, catching the screened

gravel and running it in a car down to the edge of the river, dumping it into a hopper, and used an amalgamator. The gravel was about forty-five feet above the channel of the river.

That fall, he believes in October, he returned to the river again and stayed until about May or June. He went down the river to the mouth of Hanson Creek, and again worked the Moquie Bar. (R. 4902–4903.) Supplies were brought in the same way. The boat he had would draw about fifteen inches of water. During this period Mr. Ryan came down from the California Bar, and he went with him up to Good Hope, a distance of about twenty-one miles, after the mail, in a boat and back. (R. 4903–4904.)

In going upstream he would row and tow, and also did some poling. This was in Mr. Ryan's boat, which was about sixteen feet long and three or three and one-half feet wide, a flat bottom boat, with a very light draft when not loaded. He believes the boat that he had would draw fifteen inches when loaded. (R. 4904–4905.)

He knows a many by the name of William Mitchell. Mitchell came in with a load of supplies to Hanson Creek the second fall he was there, brought in a boat that he put together there, equipped it with a steam boiler and engine, and went down the river to the Klondike Bar. He took a short ride with Mitchell in his boat, but he did not go on down the river with Mitchell. He believes that when

Mitchell loaded his boat and started on the downstream trip, he had on about three tons of commissary supplies and mining equipment. The mining equipment consisted of a car and track, the steam boiler and engine, picks and shovels. (R. 4905–4906.) Mitchell's boat was about twenty-five or twenty-six feet long, about ten feet wide, and loaded would draw about eighteen inches of water. This was in the forepart of the winter.

He saw Frank Bennett and Mike Ryan, who were operating the California Bar, several times. They used to come down the river to see him; he would go up and see them, and they would visit back and forth. Going upstream they would row or pole or tow, and used light-draft boats. (R. 4907.)

It was the first of the year of 1901 that Stanton's party came down with two or three boats, putting up notices of placer claims. They went on downstream past his place and he did not see them when they came back up at any time. The Stanton boats were carrying camp supplies. (R. 4908.)

He knew a man by the name of Andy Strauss. It was during that period that Mr. Strauss and a party came down from Dandy Crossing, stopped at his bar, and did some prospecting. Strauss had two boats and the party consisted of five men and two ladies, one of the ladies being Mrs. Strauss, and the other the wife of a gentleman from Boston. The boats were about sixteen or eighteen feet long,

and he presumes they were flat bottom. They went about six miles below Halls Creek to the Little Anderson Bar, and Mr. Strauss worked that bar, as he visited them once during the winter. (R. 4909.) He believes that Strauss had five or six men working with him on the bar.

Mr. Strauss came up a short time after he went down, stopped at their bar for a little while, and went on upstream. This was in the spring of 1901 or the winter of 1899. In his judgment, when the Strauss boats were going downstream they would draw about eight inches if they were not heavily loaded. Coming upstream Mr. Strauss used one of the same boats. (R. 4910.)

Bert Seabolt was managing the Good Hope Bar. He and Mr. Ryan made a trip to the Good Hope Bar after the mail. Usually the Good Hope people were making various trips up and down the river with boats for supplies to Dandy Crossing, and would bring the mail down that far, or some of the party would bring the mail and distribute it as they came along. They would relay the mail for parties working further downstream. The Strauss Party would at times come up and get the mail from him. (R. 4911.)

In going upstream on these trips he would row and pole and tow. If it was easy water he would row, and on swift water he might tow or pole. It would depend on the ground he had to walk on and on the stage of the water. It is a change, in going

uptsream, to row awhile, pole awhile, and tow awhile. (R. 4912.)

He is not positive whether it was the fall of 1888 or 1889 that he first went on the river, but to the best of his recollection he went out the second time in 1900 or 1901. In the spring of 1901 or 1902, he went to work for the Moquie Mining Company. (R. 4913–4914.) Frank Bennett was the manager for this company, and they were operating the Olympia Bar. On this third visit he worked for the Moquie Mining Company, who were operating on the Olympia Bar.

He went on the river at Hite on this trip. He built a boat named the *Lucy B,* which was twenty-eight feet long and about eight feet wide, with three and one-half foot sides. He took the *Lucy B* to the Olympia Bar, and took the engine and outfit, but it was not installed, and he only got downstream with the boat. He loaded the outfit in the boat and had two other boats and a raft, and there were eight in the party. The *Lucy B,* he believes, was loaded with about two tons of commissary supplies and mining equipment. The other boats were small, about sixteen feet long and three feet wide, flat bottom. The raft was about twenty feet long and about fifteen feet wide, and carried lumber and supplies; perhaps 1,000 to 1,500 feet of lumber and some grain on top, and he does not remember whether or not there was more than one man on the raft. (R. 4915–4916.) He believes the *Lucy B*

would draw about fifteen or sixteen inches of water. It was about thirty-three miles down to the Olympia Bar, which is located one and one-half miles above the mouth of Smith Fork, or thirty miles below Hite. (R. 4917.) There was no difficulty encountered in taking the raft of lumber, the *Lucy B*, and the other two boats down to the Olympia Bar, as he recalls they never were hung up any place. He did not know whether the engine was on the raft or on the boat, but in any event it was taken down on one of the boats or on the raft.

He stayed pretty closely on the river until about 1904. (R. 4918.)

During this last visit he went upstream in the *Lucy B*. He had put in a two-cylinder engine. It was built, he believes, by a company in Denver, who installed it on one of the first automobiles, and used hot tubes for the ignition instead of electricity. It was supposed to develop about six horsepower, but it did not develop over two or three, in his opinion. The engine quit a good many times, both going up and down stream, and sometimes while the boat was standing still. (R. 4919–4920.)

He made one trip upstream with Mr. Bennett and Hugh Montgomery. They went to Good Hope and got a load of lumber and supplies, and mining equipment, and came back. While at times the engine would quit they used the power all the way. He made a trip to Moquie Bar with the *Lucy B* and

got some rails and things and came back. (R. 4920–4921.)

He is not sure whether the *Lucy B* was built in 1902 or 1903, but there was only the one boat built that had an automobile engine in it, up until the time he left the river, that he knew of, although there were many other boats built. The engine was taken out of the *Lucy B* on account of a broken piston ring, and the boat was operated without power from then on. He took several trips with it after the engine was taken out. (R. 4922.) He took one trip with Mr. Bennett, Bill Hyer, and Charlie Herrick, as far as Dandy Crossing, got a load of supplies and came back as far as Good Hope. Mr. Bennett and he built a raft, and brought the raft down to the Olympia Bar, as he remembers. They had about two tons of supplies. In going upstream they sailed a good part of the way, and part of the way they rowed and towed. If the wind was in the right direction they would sail.

He knows the rapids called Bull Frog, and he made a trip down below Halls Crossing to where Strauss was operating the Little Anderson Bar, got a load of pipe and sailed practically up the Bull Frog Rapids. He got almost to the top and the wind lulled, he had to help it a little way, and then sailed most of the way from there to the Olympia Bar. (R. 4922–4923.)

During the summer of 1902 or 1903 he made several trips, one or two trips to Hanson Creek

after supplies, and one trip from the *Lucy B* after the engine was taken out.

His first remembrance of sailing much on the lower Colorado was after he took the engine out of the *Lucy B,* and the following winter, after he went to work for Mr. Bennett, Mr. Herrick and he stayed on the bar and did a little placering, and was watchman. They made several trips to Good Hope for their mail, and would always sail. They would wait until a day when the wind was blowing. He never had any trouble with sand bars unless he was going upstream, and would try to keep in too close to the shore to get easy water. (R. 4923–4924.) Going downstream he never had any trouble with lack of water, and never had any difficulty with sand bars when his boat was in the channel of the stream, in all his experience on the river. He does not believe that that winter he made any trips to North Wash. He thinks it was the following winter, about the time of the holidays, when he and a fellow named Perkins took a little boat from the Olympia and went up as far as North Wash, rowing, and towing, and sailing. At that point they picked up a fellow named Wilson, and went up to Dark Canyon. (R. 4925.)

At the mouth of North Wash there is North Wash Rapids, some swift water, and at the mouth of the Dirty Devil there is swift water. From there up to Mill Creek Bend is nice smooth water, quite

quiet water, and from there up to Dark Canyon there is swift water and rapids.

As he understands it, Mill Creek [redacted]end is at the foot of Cataract Canyon. He believes that it was in the spring of 1903 or 1904 that he went as a watchman on the old Stanton Dredge, and he continued in that employment for six or seven months, and was also running the Navajo trading post. His first supplies came in at Hanson Creek, and he boated them to the dredge. Some of his other supplies came in about a mile or a mile and a half below the dredge at Wilson Creek. On one trip he got them from the mouth of Wilson Creek with the scow, which was formerly brought in at Hite, and it was used to bring the well rig down as far as California Bar. This scow was afterwards taken and used for boating from the lower landing, which is called Wilson Creek, up to where the dredge was. After that there had been a four horsepower Fairbanks-Morse engine installed with a stern wheel, and he used this outfit to bring a load of supplies. This four-horsepower engine had enough power to go upstream through the still water, but up above the dredge when he got to Moquie Canyon there was a rapids there that he could not go up. (R. 4926–4927.) This is called Moquie Canyon Rapids, or Aztec Rapids. He did not install the four-horsepower engine. It was already installed on the scow, which was about

twenty-eight or thirty feet long and fourteen feet wide, and he operated it himself. (R. 4928.)

With the loads he had he does not believe it would draw over eight or ten inches. He took loads of stuff to trade with the Indians. The trading post was right at the dredge and the supplies came from Wilson Creek to the trading post, about a mile or a mile and a half. (R. 4929.) He was operating this trading post for Frank Bennett and himself. He received mostly blankets, some baskets and pottery from the Indians; sold some of the products he received in Salt Lake City, and shipped some to Denver. The Indians would come in by horse right across the river, he would go and get them in the boat and bring them to the camp, and when he got through he would take them back across the river. He believes the Indians used the old road that used to go across at Halls Crossing and off towards Bluff, leaving the road by the lake and come over to the dredge. (R. 4929–4930.)

Before he had been on the dredge, and while he was watching the dredge, he did some sailing on the river. He has been to Halls Crossing several times. Once, while he was watching the dredge, Mr. Turner came to Halls Crossing, and he went down with a boat and helped Turner go down to the Anderson Bar, where Strauss had operated, to take some engines across the river, and he sailed back to the dredge the entire distance. It would be impossible for him to state the number of river

trips that he made during his experience on the river. There is one stretch of the river up above Red Canyon and below Hite, of about four miles, that has a difficult turn and he has never sailed on that, for when you have the right wind to sail on the other part of the river, there generally is a reverse wind there. (R. 4931.) He has never struck it where the wind was right to sail up around there, and that is the only section of the river that he has not sailed over upstream. He does not remember of ever trying to sail downstream.

He went out from the river in 1903 or 1904 and was away for practically a year. He returned in 1904 or 1905. (R. 4932.)

He went with Frank Bennett to the Moquie Bar, started a camp and stayed there a while, but did not do any placer mining. He took a trip to the Olympia Bar and brought back some things. He was using the *Lucy B* and brought back some camp equipment. At that time the engine was out of the *Lucy B*, but he never saw this boat with a side wheel on it, as it had a stern wheel about four feet in diameter. (R. 4932–4933.)

He does not remember ever seeing a side-wheeler on the river.

In 1904 or 1905 he did some work for Cass Hite up at the Tickaboos and Red Canyon. He believes he went up the river from Moquie Bar to Red Canyon and made two or three trips from Red Canyon

to Dandy Crossing after supplies, a distance of about twelve miles. (R. 4934.)

He would get lumber and grain and commissary supplies. He made a raft, which was towed down behind the boat. The raft carried about one thousand pounds, or perhaps a ton. It was about sixteen or eighteen feet long, and ten feet wide. On that trip he was using a small sixteen-foot boat. This was before Mr. Loper's day. During that winter he went down the river a short distance below where the San Juan comes in, with a fellow from the Klondike. They were prospecting. (R. 4935.) He does not recall the man's name. He just went by the nickname of Klondike. They went down to look at a bar that he had heard of down below the San Juan River. The bar did not have any name that he knows of, but was about half a mile or a mile below the mouth of the San Juan. They stayed on the bar overnight and part of the next day and came back up the river to Cass Hite's. They poled practically all the way, but did a little sailing and a little rowing. Klondike was an expert poler and taught him how to pole with two men in a boat, one man in the bow and one in the stern. He had the best success he ever made by man power, coming up the river. (R. 4936–4937.)

This trip was made in either the latter part of December or the first part of January, and they did not have any trouble with ice. The difficulty encountered in going up the rapids was the hard

work in poling, but they poled up every rapid without having to get out; they did not put a tow line out. He recalls a place near the mouth of Lake Canyon where there is a ledge of rock that comes down into the river, it extends out into the river and there is a channel at that place. (R. 4936–4937.) The channel is nearest the right side going down and is twenty or twenty-five feet in width. Going up he did not take the channel but going down went in the channel, and the boat did not strike anywhere. He would strike when he was not in the channel, and usually going up the rapids he would stay where it was slower and easier water, and lots of times go along the rocks where there was less current. The water that goes through the channel is swift water, and he was looking for the easiest water he could find. (R. 4938.)

He had just been down and back over this place during low water. In the fall of 1905 he believes was the time he took an option on the Adams ground and placered there. He was in there part of the winter of 1905 and the beginning of 1906. He was in partnership with Frank Bennett; they got their supplies from Hite by boat, and he made trips up and down from there. (R. 4939.) This was the Adams Bar at Red Canyon. He was first in there for Mr. Adams, and the last time he was on the river with Mr. Bennett they had a lease on the bar and operated it themselves.

The other time he was there was in the forepart of 1905, on a different trip. He left the Colorado in the spring of 1906 and was not back until about 1925, when he went into the river at the mouth of Hanson Creek, and did some placer mining at the California Bar. (R. 4940.) He was there for about three months, and Charlie Hunt was working for him. He hauled his supplies to the mouth of Hanson Creek by team and took them up the river and across to the California Bar by boat. At that time there were no other parties placer mining that he knew of. He took a trip to the Olympia Bar to get some mining equipment, and also made a trip to the old dredge to get some things. He was using a small sixteen-foot flat bottom boat about three feet wide, and a draft of only a few inches empty, and not a great draft loaded. (R. 4941.) This trip was his last trip on the Colorado River. During the period of nineteen or twenty years that he was away from the river, between 1905 or 1906 and 1925 or 1926, he noticed very little change in the bed of the river or in the river. It looked about the same and everything seemed natural.

In his experience on the Colorado River there were times when a big flood came down some of the side canyons, which would carry in sediment that would push the river towards the opposite bank for a short period of time, but from his experience there would always be a channel to go up or down the river. These deposits of sand and silt that came

down from the side canyons would extend out for a few days, but the natural flow of the river is so much larger where the main stream is that it carries it on, and he has never experienced any difficulties in navigation because of these conditions. (R. 4942–4943.) There were years when he stayed through the summer months and there was a period of more than a year when he did not leave the river at all. (R. 4943.) That period was from the time he went to work for the Moquie Mining Company, up until after he watched the dredge. He was there all that time continuously. Might have been out for a day or two making a trip to Loa, or maybe a week or two, and that was in a period of about two and a half years. He has had other experience at other times and places with power boats in the States of Utah, Oregon, and California. (R. 4944.)

He has had personal experience with four horsepower, one horsepower, and one and one-half horsepower motor boats, which last motor was in the *Lucy B.* Four-horsepower motor boats have been about twenty-eight feet long and about fourteen feet wide. This was a scow that he used when he was watching the dredge and for trips he has mentioned. (R. 4948.) The launch he used, which was about twenty-six feet long and perhaps seven or eight feet wide, had more horsepower than any of them. He would judge it was thirty or forty horsepower, and he operated this at Arrowhead Lake in California.

On the Columbia River he operated a modern, up-to-date boat, perhaps twenty feet long, with one and one-half horsepower motor on it. He does not believe this boat would make all of the rapids on the Colorado River. (R. 4948–4949.)

Up as far as Hite, in his judgment, it would require a twenty-horsepower motor to take a twenty-four-foot boat with a load of a ton or more up the Colorado River, through the sections he is familiar with, and a boat of this kind would not have any difficulty in going up the rapids. (R. 4950–4951.)

Cross-examination (R., Vol. 28, 4951–4962):

He was born in 1885, and his first boating experience was when he was twelve or thirteen years old. The only difficulty he had with sand bars on the sections of the Colorado River that he had experience on was in going upstream; not much difficulty going downstream. (R. 4951.) He does not recall at any time that he had to get out in the water to get off a sand bar. He has no recollection of getting out, either going up or downstream. He has seen other people operate boats and has seen them get in the water to get the boat off a sand bar, but he has only seen this very few times, and they were not people in his party, although it has been necessary in a boat he has been riding for some other member of the party to assist the boat off a sand bar. (R. 4952.) This has happened occasionally when he might be sailing up-

stream and taking the slow water, and ran on to a sand bar. Maybe some of them would have to get out and push it off, but usually if that occurred he used the pole and would push from the boat. At any rate it did not happen many times. In going downstream in a boat or raft that he has been riding, it has never been stuck to the extent that it was necessary for anyone to get out and push it off. This has never happened, and any boat or raft he has been riding on has never been stuck on a rapid, although he may have been going upstream and run in, hit a rock, and pushed off or something like that. Sometimes it would be necessary for some member of the party to get out and help the boat off. (R. 4953.) This has been infrequent.

He recalls one rapids as being Hanson Creek, but he never recalls that this happened on Trachyte Creek. Trachyte Creek is right below Hite, and North Wash Rapids is just above Hite, but it never happened to him at North Wash Rapids, and he never saw any boat stuck there.

In the twenty-horsepower motor boat that he said could be operated upstream, he was contemplating a flat bottom boat twenty-four or twenty-eight feet long. (R. 4954.) It would be about eight feet wide. He had no stage of water in mind, including the spring floods and the occasional floods that came in from heavy rains. He has operated the *Lucy B* boat that would be similar, but this was

not the boat he had in mind when he answered the question. (R. 4955.) The *Lucy B* did not have a twenty-horsepower motor in it. He does not know whether or not he has operated a boat of that size with a twenty-horsepower motor. A boat such as he described, twenty-four feet by eight feet, with a twenty-horsepower motor, would draw light perhaps eight inches of water, and loaded with a ton would draw about twelve inches. (R. 4956.) With two tons it would draw about fourteen inches or fifteen inches, he believes, although the amount the boat will draw depends on the speed you are running, the water it is being run on, where and how the load was located. In loading he would want the bow of the boat loaded a little the lightest. When he said that such a boat would go up the river at all stages of water, the load he had in mind was one ton, properly distributed. Passengers would be an extra load. It is a matter of power on the Colorado to go up the river in a power boat. When he answered the question he did not have any passengers in mind, only a one-ton load, including the ones who were operating the boat and the ton of load to go up the river. He figured on two men and a ton of freight, but he has never seen a boat of that description on the Colorado River. He has never operated a boat of that description on any river. (R. 4957–4958.)

When he and Klondike went down to the mouth of the San Juan he was never out of the boat to

assist it in the course of his operation. He just guessed at the width of the channel at Lake Canyon. It was twenty-five years ago that he saw it, and he has not thought very much about the channel since then. When he said it was twenty feet wide, it is just a rough guess. He doesn't mean he tapelined it or got out and poled it. (R. 4959.)

The Stanton dredge was located about a mile and a half above Wilson Creek and a mile below Moquie Canyon. Wilson Creek comes in on the west side. He recalls a bar in there called New Year Bar, and the Stanton dredge was up the river about a mile or a mile and a half above this bar. The New Year Bar was about a mile long, he believes. (R. 4959–4960.)

There was a road down Wilson Creek that was used by Stanton to bring in his materials and supplies, and he also used this road to get in most of his supplies for the trading post. They would come down the Wilson Creek road and then up in a boat about a mile to his trading post. The trading post was on the west bank of the river, and the Indians came from the San Juan Region on the east bank, would cross the river in his boat with their blankets, and he would then take them back with supplies they bought. He operated this trading post for about six months, and after that a fellow named Johnny Newby watched the dredge and operated it some. The goods that he got from the Indians were taken down the river in a boat by the

Wilson Creek Road and sent out that way. (R. 4961–4962.)

Redirect examination (R., Vol. 28, 4963):

He usually took his goods out as he has just described, but at one time he believes he took some and sent them out by way of Hite. He took them up to the Olympia Bar, and Bennett, who was his partner, took them out by Hite. He would go as far as Good Hope by river, and he might have gone on with packs; he does not know how he went from there.

Newby ran the trading post in the latter part of 1905 and the fore part of 1906. (R. 4963.)

Recross-examination (R., Vol. 28, 4964–4972):

He had a kind of shack at his trading post about a mile and a half above Wilson Creek on the west side of the river, and he would cross the river to get the Indians. During the time he was running the trading post on the Colorado River on Wilson Creek, he forded some of the Indians across to go out to the mountains to hunt, and he swam horses across the river at different points, but he never forded it on foot, and he never rode a horse across the Colorado River. (R. 4964–4965.) He used to have horses down on the bars he was operating that were used in connection with the placer operations. He had horses at Moquie, Olympia, on the California Bar and at Red Canyon. In crossing over

to Red Canyon he would lead the horse into deep water and tow it behind the boat, right above Tickaboo Rapids. (R. 4965.)

At one time he came in at Tickaboo and took them up to the canyon and took them across overland. When he would come down Hanson Creek he took them to the Moquie or the California Bar overland. (R. 4966.)

He never brought in any supplies to the various camps or bars the entire distance overland with pack burros, horses, or mules, but he has brought them in by wagon to the river, and supplies were not brought down to any of his camps in anything else but a boat, either up or downstream. He has made trips on the river at all stages of the water, both up and down stream. This includes the spring and summer floods. (R. 4967.) It did not make any difference to him what stage the water was; he would take his boats and go up. If he had supplies at any point at high water, he went and got them. He usually avoided high water as much as he possibly could, but he has gone up the river in both high and low water. The only difference the high water makes in the operation is to make it harder, and for that reason he avoided as much high water as he could. In his experience he considers May and June as the high-water months.

He has only noticed very slight changes in the channel from day to day when he was there continuously. (R. 4967–4968.) There might be a

flood come in and bring a little sand bar to the mouth of the canyon, and when he would go down he would notice it was pushed out a little way and it might be squeezing the channel a little, but the various changes in the stage of water from day to day did not have any effect on the river bed or the location of sand bars that he could notice. Moquie Canyon Rapids and Aztec Rapids were the same, although there is another Aztec Rapids further down [the river]. (R. 4969.)

The part of the river bed that he worked on during his various operations was always above high-water mark, and he never worked below high-water mark. Most of his supplies were purchased in Loa, Wayne County, but some were purchased at Greenriver, Utah. He never had any supplies which came in from Greenriver, Utah, by boat. When he came down in the *Lucy B* he built the raft on the first trip right at Hite before he started. (R. 4970.)

He rode down in one of the boats, not on the raft, and before he got to camp the boats, as he remembers, went ahead of the raft, but he does not remember any of the party that went down overland. The raft did not encounter any difficulties that he knows of. When he and Klondike went down to the mouth of the San Juan he started just below Red Canyon, prospected as they went down, he believes they got there the evening of the second day, and were five days on the entire trip. It took

them two days to go down and three days to come back, and they prospected both ways.

When he returned to the river in 1925, the only other man that he saw was a fellow named Carpenter at Red Canyon, but whether he was placer mining or not, he does not know. He saw no other boat except his, either going down or coming upstream. (R. 4972.)

Redirect examination (R., Vol. 28, 4972–4973):

His brother, George, was with him when he went on the river the first time, stayed there, and went on some of the trips with him. He was also there the next year and went on some of the trips. The occasion that he testified to, when he assisted the Indians in fording the river, was at the mouth of Wilson Creek. He took the Indians, their saddles and things in a boat, towed the horses, and the horses had to swim. (R. 4972–4973.) He was paid for that. (R. 4974.)

THOMAS FOTHERINGHAM

For Defendant

(Record, vol. 28, pp. 4975–4993)

He is sixty-two years old, resides in Salt Lake City, and his occupation is that of foreman of the barns for the Salt Lake Transfer Company. (R. 4975.)

He was on the Colorado River in 1888 and 1889, got on to the river by the way of Escalante, and went to Hole-in-the-Rock. There were four of them in the party and they were hunting gold. He does not

know how many thousand feet of lumber they hauled down to the Hole-in-the-Rock before they started to work, but they were about a month getting the lumber down, and in addition, they carried food, tools, and machinery. (R. 4975–4976.) After they arrived at Hole-in-the-Rock, the first thing they did was build a boat about thirty-eight feet long, by sixteen or eighteen feet wide. It was a large flat boat, and they had a tub on it about six or eight feet around, and paddles that worked in the tub. They intended to use the outfit in placer mining, and also had a water wheel forty feet around, built on the boat. (R. 4977.)

There were two decks on the boat, they slept on the lower deck, and had their provisions and chemicals down there. On the upper deck they had a carpenter's and blacksmith's shop, with anvil and tools, and the cooking was done on the upper deck. They also had a hydraulic pump and hose, four different kinds of screens, and had two amalgamating boxes. (R. 4978.) There were seven amalgamators in each box, and he would judge the load that was put on the boat was two or three tons. In addition to this boat they built a small skiff at Hole-in-the-Rock. After they got these boats built they went down the river in the neighborhood of eight miles, pulled in in an eddy and went to work on the bench above. The cliffs were up twenty feet above the boat where the bench ran back; they were prospecting mostly, and would wheel the dirt in wheelbarrows. This was about December, 1888. (R. 4978–4979.)

He never heard any names for any of the bars on the Colorado River at that time; that is, the bars that they worked for gold. The first place he stopped was, he would judge, about ten miles above the mouth of the San Juan River, and on the next trip he moved down below the mouth of the San Juan. While he was at the first place, he went up the river, out through the Hole-in-the-Rock, and over to Escalante for some supplies. He went over to Escalante from Hole-in-the-Rock with a team and buggy. After they would take the buggy and team to Escalante for supplies, they would leave the buggy on top of the Hole-in-the-Rock and put the horses in the pasture below the river. He hauled supplies down from the Hole-in-the-Rock to the first place he worked, which supplies came down by way of the river. (R. 4980–4981.)

He later went down to another place below the San Juan and worked for probably two months on a bar that was off to the side of the stream, and while there he did not make any trips for supplies. In going back to the Hole-in-the-Rock from his first camp to bring supplies back, he used a small boat. (R. 4981–4982.)

The place they worked was about ten miles below the mouth of the San Juan River. While they were at this place, one of the party, J. R. Nielson, went downstream with a little boat and came back. He does not know whether Nielson is still alive or not, as he has not heard from him for thirty years. The

material they were working below the San Juan River was of a low grade and they were making slow progress. Nielson wanted to go down where he could use the hydraulic and they found a place probably fifteen or twenty miles below. (R. 4983.) After Nielson came back up they did not want to move on account of the high water, but he [Nielson] insisted on moving, so they went down. They could not pull the boat in to the place they wanted to stop; the boat was too large, bulky, and heavy and kept right on going to a few miles above Lees Ferry; never could get the boat back up no more. (R. 4984.) After they got the boat to shore above Lees Ferry, the high water was still on, and they left it. (R. 4984.) Could get downstream all right, but they couldn't get up. (R. 4984.) The big boat was guided with a sweep on each end; a paddle that worked in a clevis so you could not lose it. There is a current on each side of the Colorado River, but if you pull over into the eddy you are all right; "if you can not pull over that you go on down." They could not handle it in the high flood water that was on. (R. 4985.)

The boat was taken all the way down from Hole-in-the-Rock with these sweeps. When they started on the trip the water was low, and when they took it below the San Juan and stopped it was still low water. When they started downstream the last time he did not want to go on account of the high water, but Nielson thought they could make it, so they started out. They made a failure. (R. 4986.) After they

landed they all went out, and he didn't see Nielson any more. (R. 4986.) Nielson owned the equipment that was on the boat, and was the man that built the whole thing. They got a little gold out, he does not know exactly how much, but he does not believe they quite paid expenses. During the time he was building the boat at Hole-in-the-Rock and working at the two places on the river there were two or three fellows who came down in a boat and stayed overnight. (R. 4987.) He also saw three outfits of trappers, two going down and one going up. The first trappers he saw was while he was at Hole-in-the-Rock. There were two men going downstream in one boat and they had a pretty good load of furs. He was at Hole-in-the-Rock when another fellow passed and went up. When the two went up he was down near the San Juan, and when the other two came down they came from Greenriver or somewhere in that part, but he does not know where from. (R. 4988–4989.)

There were three different boats, with two men in each boat, making six trappers he saw. The other two parties did not have as many furs as the first ones, and he does not remember any of the trappers' names. (R. 4988–4989.)

When he was moving the big boat from Hole-in-the-Rock down to that first stop, he did not get hung up anywhere; went right along. Did not have to get out and shove the boat anywhere, or pull it; they just used the sweeps on each end; they would

pull it around any place they wanted to, and start right downstream.

When he moved from his first stopping place down to his next place below the San Juan, he did not have a bit of trouble there; never got hung up at all.

When he made this trip back up to Hole-in-the-Rock with the small boat to get supplies and coming down with that boat, he did not have any trouble with the sand bars, or any other trouble. Never had no trouble at all. (R. 4988–4990.)

Cross-examination (R., Vol. 28, pp. 4890–4893):

He does not know where the machinery was purchased, but he believes it was in Milford or Beaver, and he joined the expedition at Beaver; that was where he was employed. He did not have any financial interest in it, and was just working for wages. (R. 4990.)

He believes it was in April that he went down the river in the high water. To operate this placer mining they had to wheel the dirt; they had sluices run up with screens on, heavy screen and fine screen, go down in this hopper on the boat; there was a tub, stirred the mud up and raised a door on each side, let it run down through the boxes with the amalgamater, seven amalgamaters working against the screen in these boxes; they all worked in the screen. (R. 4991.) He worked mostly on the high bars and never any of the lower bars.

He has helped to take the small boat upstream. (R. 4991.) He would go up one side where the water

was still and quiet and then cross over. He did not tow the boat any of the way; he was always able to row it up, as the river was quite still, and no riffles to speak of. He did not go upstream after the high water in the spring commenced to come down, and he made all his trips upstream in low water. The river never froze over while he was there, but he was just there the one winter, and has never been back since. (R. 4992.)

Redirect examination (R., Vol. 28, p. 4993.):

The big boat, when it was loaded on the journey down from Hole-in-the-Rock to the camps above and below the San Juan, would draw about eighteen inches of water. (R. 4993.)

CLARENCE ELMER BALDWIN

For Defendant

(Record, vol. 29, pp. 4996–5091)

He resides at Moab, Utah, 49 years of age, and is financially interested in the Moab Garage Company, being one of the principal owners and Vice President. He is a brother of Virgil Baldwin, who works for the Moab Garage Company, and who is a witness in this case. He personally operated some of the boats of the Moab Garage Company, and personally gave his attention to the running of the boats, looking after all of them. (R. 4996–4998.)

The first boat he operated was called the *Punkin Seed*; it being a round-bottom boat, the shape of a pumpkin seed, about twenty-one feet long and nine feet

wide, approximately; with a draft around twenty to twenty-two inches. This boat was used for hauling passengers and light freight.

(Defendant's Exhibit No. 21, marked by reporter and identified by him as being a picture of the *Punkin Seed* boat. (R. 4998–4999.) This boat was put in operation in the spring of 1925.)

The boat was operated with a model "T" Ford motor taken from an old Ford car, the motor when new being about a twenty-two horsepower engine. The boat carried from one to ten persons, together with light freight such as groceries, fishing tools, etc. He personally operated the boat between Moab and the Shafer No. 1 well; he also went to Lockhart with it on a few trips, the period of his operations being three or four months. It took him about four hours to go from Moab to Lockhart, and about seven or eight hours to make the return journey, the speed depending in some degree on the load carried: (R. 5000–5001.) Loads would be carried both ways if there were loads to go, consisting of passengers principally on the way back, or up the stream, but he does not recall what he actually did take back up the river. He did, however, take tools that needed repairing and quite a bit of various kinds of freight from oil wells while drilling was going on. (R. 5002.) Anything that was light and that it was necessary to get out in a hurry, if the big boat wasn't available, he would take on this boat, but the principal use of the boat was for passenger service.

There was also a smaller boat twenty feet long, four and one-half or five feet wide, operated with a model "T" Ford motor taken from a Ford car. This boat was commonly called the Black boat. (R. 5003.) He personally operated the Black boat for a period of about seven or eight months between Moab, the Shafer No. 1 well and No. 2 well, and Lockhart. Passengers were carried on the Black boat, ordinarily about four being carried, but he has had as many as nine on it; the boat was, however, overloaded. Small items of freight were also carried on the Black boat. (R. 5004.)

It would take, usually, about four hours to go down to Lockhart and seven or eight hours to come back.

There was also another smaller boat than the barge equipped with a Chandler motor and sometimes referred to as Clarence's boat. This boat was twenty-six feet long, about six feet wide at the top and five feet at the bottom. He would judge the horsepower of the Chandler motor to be about thirty-eight. (R. 5005.)

Defendant's Exhibit No. 23, recognized as a picture of the Chandler boat. The boat next to the bank in Defendant's Exhibit No. 22 is the Chandler boat, it being tied to a small rowboat, or skiff. The big boat on which several passengers appear is the Moab Garage barge. The Chandler boat drew about nineteen or twenty inches of water empty, and loaded it drew about two feet. It was used principally for

passengers and light freight. He has carried as high as ten passengers on it and as high as two tons of freight, although twenty-five hundred pounds made a good load for the boat.

Besides operating the Chandler boat between the Shafer No. 1 and No. 2 wells and Lockhart, he also made one trip to the junction, he thinks.

He went up and down the Slide with the boat and had two passengers besides himself. This trip was made in the fall of the year at the low stage of water and he had not a bit of difficulty getting up or down the slide.

He personally operated the Chandler boat in regular service over a period of about sixteen months. The round trip from Moab to Shafer No. 1 well would ordinarily take from three and one-half hours to five hours, according to the load. (R. 5006–5008.) The round trip from Moab to Shafer No. 2 well would require around seven or eight hours, depending on the load, and from Moab to Lockhart would require about four hours, and the return trip would take six or seven hours.

When he went down from the Slide to the Junction it took in the neighborhood of six hours or a little more, six or seven. (R. 5009.)

It required from ten to twelve hours to go back from the junction to Moab, inasmuch as he wasn't so familiar with the river down there and wouldn't run so fast. (R. 5009.)

In operating the *Punkin Seed* up and down the stream they had trouble with a sand bar once in a while but it didn't bother much with that boat, it being easy to get off; he doesn't think that he was ever held up on a sand bar more than five minutes with that boat. He never had to get out of the boat and push it off, as they would generally slide right off. He believes he had to get out of the *Punkin Seed* only once to get it off a sand bar or any other obstruction. (R. 5009, 5010.) On that occasion he was delayed about ten minutes.

While operating the Black boat he would hit a sand bar once in a while but was not hung up over ten minutes, it being a shallow-draft boat. They had less trouble with it than any of the others.

On the occasion when he got out of the *Punkin Seed* and was held up for ten minutes he just missed the channel a little bit. There was a channel there such that had he followed it he would not have been delayed. Also upon the occasion when he was delayed ten minutes on the Black boat, the delay was caused by missing the channel. (R. 5011.)

When operating right along they would hardly ever encounter any trouble, time after time going through without touching anything. During the six or seven months and the sixteen months that he operated the boats spoken of he would go down the river from one to four times a week, making the round trip.

He never had any serious trouble or difficulties in navigating the Chandler boat the sixteen months it

was operated by him. The longest delay he had during the time he operated the Chandler boat was caused by burning out a bearing and the boat was hauled home on the big boat, causing a delay of a day or two to have a new bearing installed. (R. 5012–5013.) Aside from that, the longest time he ever recalls being held up while operating the Chandler, was not over thirty minutes, he being held up three or four times that long. In operating the Chandler boat he would get on a sand bar for a minute or two or five minutes. When he was operating the *Punkin Seed* and the Black boat the percentage of trips on which he would encounter difficulty was less than with the Chandler boat. (R. 5013.) While operating the three boats he has so far testified to, he made about one hundred round trips; and these trips were made during every month in the year.

His company also owned the large boat or barge, shown in Defendant's Exhibit No. 22. The people on the barge in Defendant's Exhibit No. 22 are members of the Federated Clubs of State Ladies' Clubs. (R. 5014.)

Aside from the *Punkin Seed*, the Black boat, the Chandler boat, and the big barge, the company had three small out-board motor boats that were operated from time to time.

The draft of the *Punkin Seed*, under ordinary load was about twenty-two inches, and the draft of the Black boat, according to the load, was eighteen or nineteen inches. All of the boats had submerged

propellers. The Black boat was a lighter boat than the *Punkin Seed*, the *Punkin Seed* being constructed of double plank redwood. It was a heavy boat. (R. 5015-5017.)

Defendant's Exhibit No. 25 is a picture of the Moab Garage Company barge, and the people shown on it are members of a party of geologists and oil men; the picture was taken during mealtime.

Defendant's Exhibit No. 24 is a picture of Shafer No. 1 well, and the machinery, equipment, material, and lumber for the structures shown were taken down to the well on the Moab Garage barge.

Defendant's Exhibit No. 26 shows a section of the barge as it is operated on the river. (R. 5017.)

The boat on the deck of the barge is just a small square-end canoe that was carried on the barge at that time. It was equipped with an Evinrude motor at times. He operated the barge on its maiden trip and at that time he knew nothing about the channel, it being before he began taking trips in the lighter boats. (R. 5018.) He had no trouble to speak of on that trip, leaving the docks at Moab at eight o'clock in the morning and unloading [at the Shafer No. 1 well] by two o'clock in the afternoon. His brothers, Virgil and Dennis Baldwin, ran ahead of him on that trip with a small boat and felt out the channel, so that he followed them on down. His brother, Virgil, operated the big barge practically all the time after the first trip.

As he recalls, he was in charge of the boat on another trip when Virgil had his back hurt, the

boat being piloted by a fellow named Newell, who was one of the operators of the barge. Virgil Baldwin, however, was Captain of the boat and did practically all of the handling of it. (R. 5019.)

The channel is very near in the same place all the time, only just after the heavy rains in the fall that come in the side canyons, bringing in the silt, that would change it temporarily, for a week or ten days it would change the channel there; it would eventually get right back in the same channel again. He did not observe any change of channels or instability of channels at any place in the river other than at the places at and in the immediate vicinity of places where side washes came in, and on the occasion of floods coming down those side washes; none to speak of; it was practically the same. At those places where side washes are located, and following heavy rains that would bring silt and anything else down into the Colorado the river in a few days would clean that out. Do its own house-cleaning there. (R. 5020–5021.)

Trouble with sand bars or other obstructions caused by floods would be encountered at the mouths of canyons below the docks on the first trip down, only very little trouble being encountered after the first trip. In a few days afterward the river would be restored to normal.

It was part of his business to keep track of running the boats and he endeavored to perform this duty faithfully. (R. 5021.)

His mother made a visit to Moab and was living there before the boats started operating. His brother, Virgil Baldwin, was his mother's baby son in whom she took considerable pride. (R. 5022.) Because of her interest in her son she kept a diary of the trips Virgil made and he, Clarence, saw his mother three or four times a week, and the diary, which she kept, and he kept a check of the trips of the boats as she put them in her diary. This diary of his mother's became more or less as a document that was used by the Moab Garage Company, being used several times to check up on dates and to his knowledge, the notations in that diary as to the trips of the big boat, are correct (R. 5023–5024.)

The diary was kept by his mother in her own handwriting, and it was taken by Mr. Perry Clark to Denver as a reference for dates. The diary correctly reflects his own knowledge of the trips of the big boat during the period it covers. His mother later went back to her home in Indianapolis, Indiana, in June, 1927, and there have been about forty trips made by the big boat since she left. (R. 5024.) Up to the time she quit keeping her diary there had been approximately two hundred trips made by the big boat. The big boat made seven recent round trips [in November, 1929], four of them being to Lockhart and three to Shafer No. 1–A well.

He recalls an occasion when the barge was caught in an ice jam, this being the only time its operations were ever stopped because of ice.

He would state as a conservative estimate that there has been hauled up and down the river by the Moab Garage Company since it started operations, in all, about thirty-five hundred tons, and there have been hundreds of passengers hauled on all of the boats for compensation up and down the river. (R. 5025.)

He has no record, but he believes that is the number. The operations on the river were commercially profitable.

The original contract for hauling on the river called for $1.75 per hundred from Thompson to the Shafer No. 1. The distance overland from Thompson to the Moab dock is thirty-three miles, and from the dock down the river to the Shafer No. 1 well is approximately twenty miles. The charge was later lowered to a rate of $1.00 a hundred from Thompson to the well. (R. 5026.) He does not know what percentage of the tonnage was delivered from Thompson to the Shafer No. 1 well at the rate of $1.00 per hundred, but the first five hundred tons went to the Shafer No. 1 well. (R. 5026-5027.) Cut to a dollar in the next three months. Most of tonnage was hauled at a dollar. (R. 5027.) They received $1.75 a hundred for the first five hundred tons.

The rate to No. 2 well from Thompson was $1.25 a hundred, the distance being about nine miles farther [down the river]. R. 5027. It is about the same distance from Thompson to the dock at Moab, as from the dock to No. 2 well; from Thompson to the dock being three or four miles farther.

It would take three trucks to move that fifteen tons; three five-ton trucks. Our drivers' wages would be fifteen dollars; the helpers' wages on the trucks is thirteen dollars and fifty cents; it would take thirty-six gallons of gas at thirty-two cents, ten dollars and fifty-two cents; four quarts of oil, be one dollar and forty cents; three trucks in traveling from Moab to Thompson and back would be two hundred and sixteen miles. They figure about four cents a mile per truck for tire cost; that makes the cost, the truck cost, forty-nine dollars and six cents. To take that on the barge from the dock to No. 2 we would have to figure two days' trip. It would take two days to No. 2 well. The pilot's wages on the two days would be twelve dollars; we have two helpers on the barge at four dollars and a half apiece, would be eighteen dollars; it would take approximately forty gallons of gas, thirty-two cents, would be twelve dollars and eighty cents; and two quarts of oil, seventy cents, that would be forty-three dollars and fifty cents for the cost of the barge compared with forty-nine dollars and six cents on the truck. (R. 5028–5029.)

His brother, Virgil Baldwin, was paid six dollars a day and board for operating the barge, and the helpers were paid four dollars and a half a day and board. He would estimate that the board cost his company about one dollar a day for each man. This item of expense is not figured in the cost of operating the barge and had to be included. The cost of hauling

by truck from Thompson to the dock would be about the same as hauling from the dock to well No. 1. (R. 5029-5031.)

Investment in the land outfit was about fifteen thousand dollars, or five thousand dollars apiece for the trucks, and investment in the water outfit was about six thousand dollars, which included change of engines; so that there was a difference of about nine thousand dollars in the investment between the land outfit and the water outfit. The trucks would depreciate at the rate of about twenty per cent a year, while the boats would depreciate at a rate not over ten per cent. He does not know what the difference in taxes between the land and water equipment was.

The highway between Thompson and the dock is a very good, well-kept highway, it being a state road, kept up at public expense. (R. 5031-5032.)

He has seen the country along the river from the river, and has been out on top in different places and describes it as being very rough country. His company has delivered freight by land to one of the oil companies operating on Indian Creek, and he has personally been over it, going down as far as Lockhart. He has been over most of the roads in that country, and his company has been engaged for years in the general freighting business.

In contracting for deliveries he endeavors to make them as low a cost to himself as possible. (R. 5033-5034.)

The only road from Moab to the river is the one that goes to Lockhart, and it traverses a very rough

country, but it is possible to get through with a truck. This road traverses country away from the river, going from Moab toward Monticello, and then down Indian Creek to Lockhart there is not a direct road. (R. 5038.) That point [Lockhart] could not be reached except by a road that went a long way from the river at places. There is no road that reaches the river between the Shafer No. 1 well and Lockhart. It would not be feasible or practicable to construct a road to any other points on the river, on account of the high cliffs and broken country. (R. 5038–5040.)

A notebook containing lead-pencil writing is recognized by him as his mother's handwriting and the diary spoken of. (R. 5040.) He knows of his own personal knowledge that the diary is a correct statement of the trips made by Virgil Baldwin on the big barge, as well as some entries concerning trips made by him on other boats. He does not know whether the diary contains all of the small trips made by his brother, but it does contain all of the trips he made on the big barge. (R. 5040–5041.)

By using his mother's diary he would be able to state of his own knowledge that each item with reference to the big boat is correct, because she made a record of each trip. (R. 5042.)

In the ordinary course of business operations his company keeps books of the tonnage which was transported on the trucks, but it has not a complete record of the tonnage hauled on the boats and the charges received. The only record of materials transported

on the boats were the bills of lading which were turned over to the shipper when he paid his monthly accounts, and they had no duplicate records, but they had a complete record of every truck and car they had. (R. 5044–5045.)

He first saw his mother's diary shortly after she started to make it, and he used it for the purpose of referring back to some trip he wished to know about. The diary has been used in connection with his business to obtain dates when they started to run the big boat and wanted to refer back to when it was built. (R. 5048.)

Mr. Clark took this diary with him to Denver and it is assumed that he took it there for a purpose. Virgil Baldwin has kept it since Mr. Clark took it to Denver, before that time it was kept in his mother's house. The diary belongs to Virgil Baldwin and his mother, from whom Mr. Clark obtained it, and from whom he, Clarence Baldwin, obtained it. Virgil Baldwin testified to a number of trips he made and if he had the book in his possession it is assumed he used it. (R. 5049–5050.)

By using his mother's diary, Defendant's Exhibit 27, to refresh his recollection, he is able to state of his own knowledge that the trips made by Virgil Baldwin in the big barge were made at times as set forth in the diary and that he can testify by referring to it because he knew it was correct at the time the entries were made. (R. 5052.)

(It is stipulated that the witness would testify upon refreshing his recollection from the diary that the trips were made by the big boat on the dates specified in the diary and that a copy of the diary may be received in evidence merely as to the respective dates and trips therein stated, all other material with reference to hearsay matters in the diary not to be considered. The truth of the entries therein is not admitted by Government counsel.) (R. 5053–5054.)

Cross-examination (R. Vol. 29, pp. 5054–5082):

The big boat, or barge, was built for the purpose of hauling supplies for the Midwest Exploration Company in the year 1925. His company had been in the freighting business with the use of automobiles for a period of ten years but they had carried no freight on the river prior to building the Moab Garage boat [barge]. They had an Evinrude boat prior to 1925 but didn't use it much—just had it down there for pleasure to cross the river and go fishing with. (R. 5054–5055.)

After obtaining the contract to haul the equipment for the Midwest Exploration Company they purchased either three or four additional trucks, one Coleman and two Max, and when they were not hauling oil-well equipment with these trucks they were used for hauling general freight to Moab, Monticello, LaSalle, and intermediate points. These trucks are still being used for that same purpose. (R. 5055–5056.)

He never saw Complainant's Exhibit No. 632, which was filed in 1926 with the Public Utilities Commission of the State of Utah, but states that the rates are about the same as charged by them. (R. 5056.) He does not know anything about filing the document with the Public Service [Public Utilities] Commission. (R. 5057.)

He has transported no freight to Greenriver, Utah, and they did not run a regular truck to Greenriver; they go there and get a load of coal oil once in a while and the last two or three months have been hauling Ethyl gas from Thompson to Greenriver, it being about the only freight to haul between those two points. Between Moab and Greenriver they haul a little coal oil once in a while. They would sometimes get a carload of feed at Greenriver and bring it back to Moab. He does not know the rate by truck between Moab and Greenriver. The trips for coal oil were made maybe once a month, sometimes once in two months. A couple of truck loads of feed were hauled to Moab this fall but there was no rate charged because it was for their own use. His company maintains a general garage at Greenriver [Utah]. They have transferred freight from Thompson to the Big Indian mine in LaSal Mountain, near LaSal. (R. 5057, 5059.) He doesn't know exactly the rate charged for transferring this freight, but they have been hauling for two or three months. He believes Mr. Clark told him they were delivering coal to the Big Indian for sixteen dollars a ton and that

when they hauled a truck load of concentrates back they charged twelve dollars a ton for it. This is a low rate. The coal comes from Sego, Utah, five miles north of Thompson, but they do not take freight back all the way to Sego. (R. 5060.) The only coal transferred overland to Blanding, Monticello, and Bluff, is for their own use at the Monticello Garage. Their competitors haul coal to different points from Thompson.

He does not know of any freight to speak of being transported on the river other than that which was taken in the Moab Garage boats. The merchants of Moab never used the river to bring in or take out supplies. Considerable grain is raised in and around Moab, but most of it is kept for feed. (R. 5061.) Wool, fruit, turkeys, and hogs are sent out from the vicinity around Moab on trucks; some individuals own trucks of their own and use them to haul their own material out. None of the shipments are taken out on the river. (R. 5062.)

The small boats were built after the barge was constructed.

The passengers hauled were principally oil men and geologists. They came in to Moab and vicinities temporarily, and their investigations extended over a period of about twenty-seven months, as near as he can recollect. Most of the passenger business was done after the oil men came in down the river. (R. 5063.)

The hull of the *Punkin Seed* is sunk about twelve miles down the river, where it is tied up to the bank, and the motor has been taken out of it.

Passengers were carried on the river for compensation, different charges being made according to the distance hauled. The rate to Shafer No. 1 well was about twenty dollars a day for the boat, or two dollars and a half for each passenger each way. The charge was twenty dollars if they took the boat after the Chandler boat was built; before that, the charge was more for the *Punkin Seed*. (R. 5064) A charge of twenty-five dollars for the Chandler boat was made to Shafer No. 2 well, or three dollars per passenger each way. A minimum of twenty-five dollars was as cheap as they could go to Shafer No. 2 with the Chandler boat; that is, whether there was one passenger or seven. The minimum charge to Lockhart was twenty dollars a day. He didn't make any trips down there but did take oil men down who wanted to stay a couple of days. If he was gone three days the charge would be sixty dollars for the trip.

The easiest time of year to operate was after the snow started to melt and the river started to rise, from April to the middle or last of July, when there was lots of water in the river. (R. 5064.) He would rather navigate the river in high water than any other time and could make as quick time up as in low water, and they didn't have any trouble operating up on the return trips.

He would operate the boats on what they called the easy side of the river, or the short side, the main current being on the long side. They would operate where the river was not so swift, where they would have eddies. They didn't have trouble with sand bars in high water. Of course, when they got away from the swift water, trouble with sand bars would be more liable. The boats had no trouble in making a headway against the current in high water. (R. 5066.) They did not run just as well in the rapid water as in the shallow water but they avoided the swiftest water; the boats could not make headway in the swift water and they didn't make much headway in the swift water when it was necessary to cross from one side of the stream to the other. When he was making these crossings his boat was never whipped around; he was always able to avoid that and hold his boat upstream in the channel. That is true with all of the boats that he handled. (R. 5067.)

The best time he ever made upstream in the smaller boats is ten miles an hour, the average upstream in low water being six or seven miles an hour with the Chandler boat, the *Punkin Seed* wouldn't make that time, it going four or five miles an hour. The speeds which he has given are fairly representative of the time made during low-water stages. He did not make as good time between Shafer No. 2 well and Lockhart as he did between Moab and Shafer No. 2, because he was not down there so often and was not

so familiar with the channel. (R. 5068.) Between Shafer No. 2 well and Lockhart he would make three or four miles an hour with the *Punkin Seed*. With the Chandler he would make five or six miles an hour loaded. He was not between those points with the Black boat.

The speeds he has given would apply to any month of the year, high or low water. To a person who understands the river there is practically no difference between the speed upstream in high water and in low water. (R. 5069.)

He has once or twice gone upstream at a rate of ten miles an hour with the Chandler boat, the trip being between [Shafer] No. 1 and Moab, with a light load.

He knocked the propeller off the *Punkin Seed* once by striking a floating chunk, which went through the guards. Aside from that he had no propeller troubles except when he burned the connecting rod out of the Chandler. He had a few minutes trouble with the bar but nothing to speak of.

He has sheared the pins on the Evinrude boat but hasn't operated it very much. (R. 5069–5070.) He never had any trouble with the other three boats.

The black boat is still at Moab but it has not been running for the last year; the engine is still in it, and it is waiting there for passengers, if any want to use it, but there has been no use for it during the past year.

The Chandler boat is still there but has not been used a great deal, having made only two or three

trips, one to the junction of the rivers when his brother, Virgil, took a government party down. (R. 5071.) The party consisted of Colonel Dent and Mr. Ryan. He has not driven the boat himself but Virgil has been down to No. 1 and No. 2 wells for the oil company to get some little tools for them. The boat is still at the docks already to go at any time and they are looking for passengers, but none have come. (R. 5072.)

The other trips spoken of were made in November, possibly finished after the first of December [1929]. The purpose of these trips was for moving oil well equipment from Lockhart, Shafer No. 1 and No. 1–A, wells. Not all of the equipment was brought out. The equipment brought out is lying at the dock. (R. 5072, 5073.)

There is not a big bar at the mouth of Mill Creek at the present time, but there is one across the river from there. At certain times of the year, however, there is a bar at the mouth of Mill Creek which has caused trouble in crossing. Trouble is usually encountered with the bar at this place in July and August when the big storms occur. The boats have been stuck on that bar at times when it was flooded, but after the water recedes the channel gets back to where it can be travelled. Trouble will be had for a week or ten days after a storm, right at the mouth of the canyon. (R. 5074.)

Extremely high water, you know, in the spring, it will get up about the 10th of June to the peak of the high water; after that goes down, you go down the

river, at first the channel will be different, but it will gradually fall right back where it was the year before; there is new silt put in there, it will leave it different. (R. 5074–5075.)

The same trouble occurs to a certain extent after the storms in August and September, but it doesn't amount to much. This trouble occurs at the mouth of the canyons or side washes and for a mile or so below. There is a different arrangement of the sand bars after the spring floods all along the river for a little while. (R. 5075.) Don't get the same effect after a heavy rain; it don't raise the river, you know; throw a flood in there it won't raise the river only six or eight inches; it will spread out after the flood empties into the river; it is not like the high water from the snow melting in the mountains. (R. 5075–5076.) This condition will continue after the flood reaches a height of six or eight feet, when you have a little change all the way down the river for a short time, then the river will drop back to where it originally was and continues until another flood. There is a flood once in a while in September, but not so much as in July and August. (R. 5076.)

They have thought about locating the dock a mile or a mile and a half further down the river below Courthouse Wash and Mill Creek, where there is room for a very good dock to be built; however, there is much sand there, and it would cost considerable to fix a road over there for the trucks to get to the dock. (R. 5077.) Once in a while they get sand

right along the bank by the dock after high water, but it doesn't cause any difficulty to speak of, because they use the paddle wheel of the big boat as a dredge and cut the sand out in that way. It has been necessary only a couple of times two or three years ago to clean out right along by the dock with shovels. (R. 5078.)

He made one trip with the Chandler boat about six miles above Moab or a little above Nigger Bill. This was a fishing trip and he went just to be going. There isn't much of a rapid at Nigger Bill but there are some right above there. He has never tried to take the Chandler boat up those riffles.

He doesn't remember exactly but he thinks his company received one dollar and a half per hundred for hauling material from Thompson down to Lockhart Canyon. (R. 5078–5079.) For hauling material down to the operations on Indian Creek he believes they received two dollars and a quarter a hundred. (R. 5080.)

The distance hauled from Thompson to the operations on Indian Creek was about one hundred and twenty or twenty-five miles. He also hauled material to the San Juan oil field around Mexican Hat, a distance of about one hundred and forty-four miles from Thompson, for which they received sixty dollars per ton. These deliveries were made overland with trucks. (R. 5081–5082.)

Redirect examination (R., Vol. 29, pp. 5082-5086):

Virgil Baldwin lived with his mother while she was there [in Moab] and he was not married at that time.

The Moab Garage Company carried all of the freight on the river, the oil companies carrying only a little stuff in their small boats. (R. 5082.)

The Utah Petroleum Company owned a boat, or barge, in the vicinity of Lockhart, but they used it. The Moab Garage Company used it for nine trips while they were putting a new power plant in their own boat.

The women who were on the boat in the picture, the ladies clubs spoken of, were not oil men and geologists. There were a lot of other people just sight-seeing who were not oil men and geologists who went down on the small boats as well as the big barge.

His company hauled a little equipment for cattlemen. (R. 5083.) The cattlemen would have their outfits between No. 1 and No. 2 wells. The material they hauled for the cattlemen was hay and grain and anything they would happen to want; one time they wanted a couple of hundred fence posts, he believes.

On the trip that he took up the river from Moab he had no trouble with the Chandler boat by getting caught on any sand bars or anything.

The casing and tools and other material they have moved out from Lockhart recently, he believes, is supposed to go to Cisco [Utah]. (R. 5084.)

The well at Lockhart has been plugged. At Shafer No. 2 the equipment is all torn down and piled up on the river bank, and the Shafer No. 1 well has been plugged. (R. 5085.)

Trouble with sand bars and other conditions below the dock [at Moab] has not been of sufficient gravity, or caused sufficient expense, to make them seriously think of moving the dock further down. They never bothered much about sand bars, only during July and August, and at other times there was very little trouble. They made their regular trips as a rule with a few exceptions. (R. 5085–5086).

Recross-examination (R., Vol. 29, pp. 5086–5088):

They had trouble with ice in the winter of 1924 and 1925 when a big piece of shore ice came loose, crossed the river in a narrow place, and caused slush ice to jam and the river to freeze. (R. 5086.) He has seen the river frozen over at Moab only once and that was in the winter of 1924 and 1925. The river is filled with large cakes of ice at a certain time every year, usually during the spring thaws in March and April. (R. 5086–5087.) At certain times, when the river would raise a foot or two, the ice would start to come down at once, great big pieces; you had to watch out when you were operating a boat; he has dodged them lots of times there. (R. 5087.) He has never stayed off the river on account of ice. (R. 5087–5088.)

Further examination (R., Vol. 29, pp. 5088–5090):

When he took the Chandler boat down to the junction of the rivers he personally operated the boat and went down through the Slide all right, because he had been through it before, in 1910, and was looking for it. In 1910, his first experience, he made a trip from Wolverton's Ranch to Lockhart and back. (R. 5088.)

The 1910 trip was a hunting trip, in October, in 1910; two other fellows, Mr. Eldred, he was the cashier in the bank at Greenriver, and Mr. George Beeson, a rancher at Greenriver, and himself, decided to go hunting down the river, so they engaged E. T. Wolverton's boat; he has a ranch about twenty-five miles below Greenriver; they drove down there, and took the propeller boat there. It has a propeller in a tunnel; and we made that trip down to the junction, went up through the Slide; as near as he remembers, that was nineteen years ago; they went up in the vicinity of Lockhart, along there. They were gone eighteen days on that trip. Had a very nice trip. (R. 5089.)

The trip was commenced in October and they got back about the 1st of November. They went through the Slide under power, the water being swifter at that time than it was when he went through with the Chandler boat from Moab. (R. 5090.)

Redirect examination (R., Vol. 29, p. 5090):

He didn't have any trouble with sand bars on that trip to speak of. He would hit them once in a while

a little bit; take a pole or oar and push right off with the boat's power; "Nice trip; I sure enjoyed it." (R. 5090.)

Recross-examination (R., Vol. 29, p. 5091):

They carried poles on the Wolverton boat to push off sand bars; they generally carried a pole in the boats. Poles were carried in the Moab Garage boat to push off sand bars and off the bank and in landing, to slow up.

It takes the trucks about two and one-half hours each way from Moab to Thompson and return. The Chevrolet mail trucks make it in about one hour and ten or fifteen minutes. (R. 5091.)

BESSIE WALKER

For Defendant

(Record, vol. 29, pp. 5092–5094)

She is 18 years of age, and made a trip on one of the smaller boats of the Moab Garage Company in the latter part of July, 1926, in company with her father, her sister, a girl friend, and three men going down. At that time her sister was 11 years old and her girl friend was the same age as she, Bessie. On the way back there were only four people, her father, her friend, her sister, and herself. Coming back upstream the three girls piloted the boat four-fifths of the way and they had no trouble at all. (R. 5092–5094.)

ALBERT BEACH

For Defendant

(Record, vol. 29, pp. 5094–5108)

He resides at Moab, Utah, and is an employee of the Moab Garage Company, having been so employed for some years. He has lived at Moab about twenty-five years. (R. 5094.) He entered the employ of the Moab Garage Company three or four years ago. He is now 40 years old. From the time he commenced working to earn a living he has been in the cattle business and was so engaged up until the time he became connected with the Moab Garage Company.

As a boy at Moab he remembers trappers on the river, especially an old fellow by the name of Rocky, and Hy and Ed Turner. These trappers brought in furs from the river on their trips. He has knowledge of there being rafting on the river above Moab. (R. 5095.)

He can not remember the date or the year but he was going up the river horseback and saw Branson coming down the river with a lumber raft, the raft being in three sections tied together. He does not recall any other time that he saw a raft on the river.

A portion of the time while in the employ of the Moab Garage Company he worked on the boat on the river, and was at times thus employed in 1927 and 1928. During these two years he worked on the boats a period of two months but he is not able to segregate the portions of the two months spent on the river in 1927 and 1928. (R. 5095, 5096.) Dur-

ing that time he was on the large boat or barge, which was in the charge of Virgil Baldwin. (R. 5097.) They had trouble on sand bars at certain times and certain places; it was due to floods that would wash down in those big canyons and change the channel of the river; you couldn't see it, that it was filled plumb full; they would try to stay in the same course they always had stayed in, and they would get up on a sand bar; then they would have to back up and back into the channel and go on down. (R. 5097.)

No obstructions were encountered to speak of other than at points in the immediate vicinity of a side wash. The condition spoken of in the vicinity of side washes would obtain sometimes three or four days after a heavy flood before the river cut back to its channel. (R. 5097–5098.) After the first trip through such a place they would have no more trouble, and aside from the places he has already indicated as hindrances he had no trouble with sand bars to speak of.

The portion of the river to which he refers lies between Moab, No. 1 and No. 2 wells, and Lockhart. He had trouble of the character testified to at Kane Spring Wash and other washes below, the names of which he does not know. (R. 5098.)

There were floods down Kane Spring Wash a couple of times while he was working there, as he remembers. He also remembers the sand bar conditions on another below Kane Wash where they had trouble, but he does not know the name of the

wash. Aside from those two places they had no trouble and would go right along.

He would judge that he made about thirty or thirty-five round trips on the boat. He could not state the percentage of time on the thirty or thirty-five trips that he was delayed by sand bars and other conditions, but it didn't amount to very much. He would judge that during the whole period they were delayed by sand bars four or five times. (R. 5098–5100.)

Q. Do you mean four or five times, or four or five trips?

A. Take it either way, I guess. I can't hardly get at what you mean. (R. 5100.)

The longest time he recalls being held up with the big boat was two hours at Kane Spring Wash. This trouble was occasioned by a cloud-burst in Kane Wash that washed silt down and changed the channel of the river. The next longest time occurred at the wash further down where they were held up about an hour. Several other times they were held up for just a minute or two but would back right off.

His work on the barge was helping to load and unload. He also piloted the boat a little. (R. 5100–5101.)

Cross-examination (R., Vol. 29, pp. 5102–5106):

The two months which he operated on the boat [barge] was not continuous operation, sometimes running for a couple of weeks and then laying off a day or two. These operations took place in the summer of 1927, and sometimes in the fall of 1928, and was

during the low-water season of both years but he is unable to say which months. (R. 5102.)

There was a winch on the boat and it was used for the purpose of stopping, for which purpose they would throw an anchor out and use the winch to pull it back. They also got off sand bars that way. He was also on the boat when it was necessary to take a line ashore, which they did by using a small boat; the line was tied to something on shore and the winch wound up by hand. He never took the line ashore himself but at one time went with a fellow who rowed the boat, down at Kane Spring Wash. (R. 5103.) At another time down below where they got on the other sand bar he saw the line taken ashore, and they were the only two times, he believes, that he saw the line taken out going downstream. He never did take the line ashore going upstream. (R. 5104.) He, nor anyone else, to his knowledge, put the anchor out going downstream to pull off sand bars, all of that work being done with the winch. (R. 5105.)

He has been on the Green River in a boat down to about Wimmer's Ranch, but he never operated the boat himself. (R. 5106.)

Redirect examination (R., Vol. 29, p. 5106):

He has never had any experience on the Green River. (R. 5106.)

Recross-examination (R., Vol. 29, pp. 5106–5107):

He is unable to tell how many of the thirty or thirty-five trips were taken in 1927 or 1928. (R. 5106–5107.)

EMELINE COOTE

For Defendant

(Record, vol. 29, pp. 5109–5115)

She resides at 836 Sherman Avenue, Salt Lake City, and is a music teacher by profession. She made a trip on the Green River in 1907 in company with Mr. and Mrs. Wetzell. Mr. Wetzell at that time was supervisor of music in the public schools of Salt Lake City.

On the trip they used a little row boat with a two-horsepower motor on it. (R. 5109–5110.) The boat and motor, she understood, belonged to Wetzell. They went down the river from Greenriver, Utah, to, she believes, Wolverton's Ranch, where the Wetzells were to spend their vacation. After staying at the ranch eight days they returned back up the river to Greenriver [Utah] in the same boat, without encountering any difficulties of any character whatever. (R. 5110.) No one had to get out of the boat at any time and they were stuck on no sand bars. There was a little stretch of rapid water just at one place where another river came in.

She has had experience on other rivers, having navigated the St. Lawrence, the LaShine, the LaShine rapids, the St. John, the rivers in Quebec, the Rider River in Ontario, the Niagara River, and the Saginy.

She has operated boats on nearly all of those rivers and has run the rapids spoken of three times, the first

time being with an Indian guide and the second time by herself. (R. 5011.)

In 1907 she went to Moab and had a boat built for the purpose of making a trip on the Colorado. The boat was about fourteen feet long, four or four and one-half feet wide, flat bottom, "just a sampan." It was designed for the installation of twin motors, which were never installed, however. She operated the boat on the Colorado River, going north from Moab to a little above Jenson, she believes, and then went south into the canyon below town [Moab], in company with Mr. and Mrs. Wilson. (R. 5112.) The Wilsons each used a pair of oars and she skulled with a single oar in operating the boat. Didn't have any difficulty only at the mouth of the river that came in there was quite a swift current; she just made a long leg and cut the current. (R. 5113.)

Cross-examination (R., Vol. 29, pp. 5113–5115):

She was on the Green River somewhere about the 20th of June [1907] subsequent to the adjournment of schools, because Mr. Wetzell went ahead and she and Mrs. Wetzell followed and were here [Salt Lake City] the 1st of July.

The trip on the Colorado River was in October of 1907. (R. 5113–5114.) Jenson is right on the river, north of Moab, on the river road, Jenson's ranch. (R. 5114.) There is a post office, or used to be. It is about twelve, probably thirteen, miles above Moab. (R. 5115.)

OTTO EMPEY

For Defendant

(Record, vol. 29, pp. 5116-5131)

He is 48 years old, of Salt Lake City, and is an employee of the U. S. Fuel Company, at Mohrland, Utah. He at one time lived in Moab, Utah, having moved there at about the age of 4 or 5 years, and leaving about 1918 or 1919.

As a boy in Moab he remembers an old trapper by the name of Powers, nicknamed "Rocky," and has seen him come in with skins after trapping expeditions. He remembers of him trapping for a period of five or six years and he doesn't know of any other occupation followed by him. (R. 5116-5117.) The furs were brought in from down the Colorado River and he has seen him come up the river with his boat.

He also remembers Ed and Hy Turner and Charlie Turner and Louis Petzell, who were trappers on the river and brought furs into Moab in their boats.

He has seen other rowboats on the river, having had one himself, and has made hunting expeditions down the river in it. (R. 5118.) He has also known others to go down the river hunting.

In all of his experience he never had any trouble with sand bars on the Colorado River.

He is acquainted with the Branson boys, and recalls their rafting of lumber on the Colorado River, which operations covered a period of five to seven years or longer. As he grew older he rode the range some and saw some of the Branson rafts on the river.

(R. 5119.) Altogether he probably saw eight or ten of these rafts.

He has also seen Billy Brown and a fellow named Welsh, who owned ranches on the Colorado River, twelve or fifteen miles above Moab, come down the river in their boats, but he never saw them go up. He does not know what became of their boats after they brought them down, but he has seen the boats left on the river after they came down. (R. 5120.) He has seen the boats tied up at the ferry before the bridge was built and up the river along the bank at their homes. He couldn't say whether they were the same or different boats, but he supposed them to be the same.

He made a trip on the *Undine*, the purpose of which was to go from Moab to the Cisco pumps. (R. 5121.) That is the only trip he made on the boat; they did not get to Cisco on that trip, but did get up ten or twelve miles above Moab, turned around and came back down. When he left the *Undine* was tied up at the ferry [at Moab]. She didn't get up to Cisco. She went about ten or twelve miles above Moab, and then turned around and came back. They came up there to one of those V-shaped riffles, and we ran the line out over it, tied it to a big rock up over the riffle, then came back and got on the boat and proceeded to go up over the stream, and the boat was carried into the swift water faster than the capstan engine would take the rope up, the boat, when it struck that current,

it went sideways out into the stream and broke the rope, turned around, and we went down and back to Moab. Went back under power. (R. 5122–5123.)

He saw where the wreck of the *Undine* had lodged, it being a considerable distance below the riffle [where the rope was broken] but he doesn't know how far it had floated downstream after it had capsized.

The effect of using the rope and capstan and keeping the power on the boat going at the same time was to cause the boat to be carried into the water on slack rope, exposing the sides to the swift current. (R. 5124–5125.)

Cross-examination (R., Vol. 29, pp. 5125–5127):

He has crossed considerable stock at Moab and at times when it was unnecessary to swim the cattle; the water would be low enough the middle of July and the fore part of August to cross stock without swimming. It requires considerable skill to cross cattle in the stream when it is necessary to swim them, but not much when they do not have to swim. When it is necessary to swim them they sometimes get in the water and mill around (R. 5125–5126), and if the men with the cattle don't know their business they lose some (R. 5127).

Redirect examination (R., Vol. 29, p. 5127):

The shallowest he ever saw the water at any of the shallow fords was when it would come about to the point of the shoulders or bellies of the animals. Even at the lowest water he always picked the place to cross and picked the shallow places. (R. 5127.)

Recross-examination (R., Vol. 29, pp. 5128–5129):

The boys used to skate at Moab on the ponds and up and down the river right near the bridge. The channel is pretty deep allof the year across there. He wouldn't say how often they had skating but there were some years for two or three years in a stretch when there wouldn't be any skating and he never saw it when there would be skating two or three years in a stretch. There would probably be a month's skating in the year, usually during the latter part of November and December. (R. 5128–5129.)

Redirect examination (R., Vol. 29, pp. 5129–5130):

Some of the winters when he skated on the river it would be frozen clear across and he has seen it frozen that way five or six times. (R. 5129–5130.)

CHARLES A. GIBBONS

For Defendant

(Record, vol. 29, pp. 5132–5151)

He resides at Greenriver and Hanksville, Utah, and is at present engaged in the sheep business.

Some time in the eighties he had occasion to go on the Colorado River, entering at Dandy Crossing at the mouth of Trachyte Canyon. (R. 5132.) He went down there because of the gold excitement, he understanding that there was gold in the bars that could be saved economically, and he thought he would try it out. When he arrived there he did some

prospecting with pans along the banks of the river and found so light he couldn't handle it and didn't go on the river at all. He reached the river overland with pack outfit and stayed around Dandy Crossing either two or three days. He remembers meeting Cass Hite at that time and there were five or six other men with him. They were building a raft for the purpose of taking a boiler down the river to Tickaboo. (R. 5133–5134.) The boiler was loaded on the raft when he got there. The raft was constructed of lumber and was probably twenty or twenty-five feet long, and sixteen or eighteen feet wide. The boiler was a sixty horsepower, but he doesn't know the weight of it. Besides the boiler they had some supplies and tools on the raft and he saw them float down the river probably a quarter of a mile, with four men manning the two sweeps, if he remembers right. (R. 5134–5135.) There were two row boats accompanying the raft, one along the side and the other with a man in it. He doesn't have any idea as to the length of the boiler; it may have been twelve or fifteen feet long; just a common steam boiler. He doesn't know the weight of the engine either.

He was next down at Dandy Crossing in the nineties in the winter, at which time he excavated a race at Good Hope Bar for the Cass Hite Placer Mining Company, and put in a water wheel to hoist the water for sluicing purposes. He does not remember whether it was the early or late nineties but thinks it must have

been 1895. The race was walled with timber and the wheel set where it would get the force of the water.

This was seven or eight years after his first trip down there. While he was there he saw the boiler that was taken on the raft during his first trip at Tickaboo Bar, which is about three miles above Good Hope Bar. (R. 5135, 5136.) From Dandy Crossing he went down to Good Hope Bar with his stock over a high trail. The teams were necessary in excavating the race. The equipment and provisions such as hay, grain, scrapers, and plows were taken down by boat and raft from Dandy Crossing to Good Hope Bar. He didn't take the supplies over the trail because it was very narrow, high, and dangerous, and he was lucky to get his horses down. (R. 5136–5137.) He did not build the rafts and boats that carried supplies and equipment, they being built by the party who was putting the plant in. The raft was probably twenty or twenty-five feet long and sixteen or seventeen feet wide, and the provisions and equipment would weigh between six and eight tons. He was on the job a little over two months, he believes, and then went out to get timber, piling, and so forth, to finish the race and set the wheel on. During that time the Hite Company got its supplies to Good Hope Bar in lighter boats and rafts. (R. 5138–5139.)

He doesn't just remember seeing any other boats besides the ones used by the Hite party on the river, but believes there were others because other people were working below and above. Supplies were

boated down unless there happened to be a light load and that would be packed down.

He doesn't remember whether Mr. Bennett was there at the time of these operations or not but Mr. Chaffin was there operating below [Good Hope Bar]. (R. 5139.)

He worked in and out of there for a long time, taking Robert Stanton's equipment and supplies in, as he recalls, in 1899. He entered the river on that trip at Dandy Crossing. The last time he remembers seeing the drill was just above Cape Horn or between Cape Horn and the mouth of Four Mile Canyon. The drill machinery and supplies were taken down the river on a large barge. It stopped from time to time and drilled a number of holes. He would judge there were ten tons of equipment and supplies on the barge. (R. 5140-5141.) [Four Mile Creek is at mile 158, about five or six miles below Dandy Crossing or three miles below Trachyte.] He didn't do anything with the handling of the boats during the period spoken of, just got on and off them and looked them over.

About 1900 he delivered a dredge and some other equipment for Mr. Stanton, as he remembers, just below Hanson Creek. The dredge was estimated to weigh one hundred and eighty tons and he doesn't remember the tonnage of supplies and other equipment taken down. The dredge was constructed a half or three-quarters of a mile above where it was launched, and material all hauled up on barges and

boats. He doesn't recall ever seeing Mr. Mendenhall at that time. (R. 5141–5142.)

He remembers seeing Meskin, Kimball, and Turner there on the river running their boats, but he does not remember how often. He remembers seeing boats go up and down the stream on his visits to the river but he does not remember who they were or what they did.

In going upstream their boats were rowed a good deal of the way; in the heavy water they had to be towed where they didn't get the advantage of back current in the riffles.

In 1916 he was running cattle at Tickaboo, and Good Hope Bar also. At that time he took a short trip up the river with Mr. Turner from the mouth of Red Canyon to Hite and back. (R. 5143.) Mr. Turner brought back with him three or four hundred pounds of supplies for the cattle outfit, and he, Gibbons, paid Turner for his services in boating. During the trip up the river they sailed the greater part of the way. (R. 5144.) He doesn't remember encountering any sand bars but it was necessary to tow the boat over a riffle or two because the wind threw them into the rough water. They towed and rowed up Trachyte rapid but he didn't get out of the boat. Turner did the towing and he had rubber boots on so that he did not get wet if he stepped into the water. He hugged the shore going up over the rapids and didn't get into deep water. (R. 5144–5145.)

Cross Examination (R., vol. 29, pp. 5145-5151):

He thinks the place where he took the Stanton supplies in the second time was Wilson Creek, but he can not remember what they did call it.

He was manager of road construction from Greenriver and built and changed the road to the place they went on the river [with the Stanton material] with the exception of the wall that was put on for going down into the river. Prior to that time there had been a road from Greenriver to Hanksville but he had to change it entirely because the men who agreed to haul for him quit because of the condition of the road. There were several places where he improved the road. (R. 5145–5146.) The road was just anywhere there, and it made it a longer distance, had to cut around, as far as the work was concerned; put in a few fills in deep arroyas that was cut, they filled them; there was no regular road building. (R. 5147.)

The road he built for Stanton is the one that is used now between Greenriver and Hanksville. From Hanksville they went south between the middle and the south Henry Mountains and over the pass, building a road so that the heavy machinery could be taken over. (R. 5147.) From the pass they went down Hanson Creek a few miles, then over the range to a point where they delivered supplies on the river.

At the point where they delivered supplies on the river it was necessary to shoot a good deal ~~of rock~~ in order to build a dugway that was very dangerous.

getting down when completed, and cost about a thousand dollars. In going down this dugway they used what they called rough locks. (R. 5148.) Teams were attached to the wagons when they went down the dugway, the wagons being unloaded immediately after they went down the steep place to the bank of the river. The steepest part of the dugway might have been a ten per cent grade and the teams would pull the empty wagons right out.

Prior to that time he had done some hauling into Hite.

When he first went in there he operated a drill and hauled the drill to the river and the material for the barge, using a three and one-quarter broad tire wagon, going all the way into Hite with the teams. (R. 5148–5149.) The freight was obtained at Greenriver, Utah. At that time he also did some hauling for the Cass Hite Company.

At that time some corn was raised around Hanksville, but he obtained grain and food for his teams from Loa in Wayne County, about fifty miles south of Richfield [Utah].

There were a good many people working in different places up and down the river in a small way in 1916 when he was there; Mr. Kimball and Mr. Turner having a plant. (R. 5150.) There were a number working below on Hanson Creek but he knew none of them except Chaffin and Bennett. (R. 5151.)

A. L. KROEGER

For Defendant

(Record, vol. 29, pp. 5151–5179)

He resides at Durango, Colorado, and is a civil engineer by profession. He has lived in Durango about twenty-five years, and in that vicinity forty-four years. He is familiar with, and has been over, a large part of the San Juan Basin and watershed in eastern Utah, New Mexico, and Colorado. He is familiar with the timber and the cuttings of timber that have occurred in those sections of the country and knows of his own knowledge the location and approximate areas of timbered lands. (R. 5151-5152.) He had verified and corroborated his personal knowledge in this respect by interviews with employees of lumber companies who have kept records and detailed information as to the exact areas and amount of cutting.

He has personally made surveys of the so-called Dolores River Project, having spent the best part of three years on that work. He is familiar from surveys made by him, of the amount of land that can be reached by gravity flow of water from a reservoir site on the Dolores River and is also familiar with the areas of land above Bluff on the San Juan River and its tributaries that are irrigated by the waters of the San Juan and tributaries and he has checked his general knowledge with the records in the offices of county assessors of various counties in Colorado and with the division engineer of District No. 7 of

Colorado, and with the records in the office of the county assessor of San Juan County, New Mexico. All of the lands in New Mexico irrigated from the San Juan and its tributaries being located in San Juan County, New Mexico, for the convenience of the court, he has prepared a map showing the sections concerning which he has been interrogated. (R. 5153–5155.) This map shows all of the principal tributaries to the San Juan River in the San Juan watershed lying above Bluff [Utah].

Defendant's Exhibit No. 28 is identified as the map prepared by him. (R. 5155.) The heavy red line around and including areas colored brown, green, and yellow, indicate the exterior boundaries of drainage into the San Juan River, and includes the area east from a line parallel to and a little west of the 110th meridian. The area colored brown on the map represents the approximate area of timberland cut over. The location and dates of installation of various saw mills that were used are indicated on the map, including, he believes, all of the larger mills. The area colored green represents the approximate location of farm lands, irrigated by tributaries to the San Juan River and the San Juan. (R. 5156.) The areas colored yellow represent land that it is possible to irrigate from the Dolores River. [The Dolores River was indicated on the map.] There are about five hundred and six thousand acres indicated in yellow in the map, about one hundred and eighty-four thousand acres being in Colorado and three hundred

and twenty-two thousand in Utah. (R. 5157–5158.) There are about seven hundred and eighty-two thousand acres of land represented in brown, which indicates the cut over timberland. (R. 5158.) About one hundred and sixty thousand acres are indicated in green; of this, one hundred and twenty-nine thousand eight hundred and forty-six acres are in Colorado, and thirty thousand and sixty-four acres in New Mexico.

The figures spoken of within the state of Colorado were taken from the records of District No. 7 and the records of county assessor. The records in the county assessor's offices show less acreage than the records of District No. 7. According to the county assessor's records there are seventy-three thousand and three hundred eighty-five acres of irrigated land in Colorado. (R. 5158–5160.) The records of District No. 7 show one hundred and twenty-nine thousand, eight hundred and forty-six acres under cultivation in Colorado. The estimates of the amount of land actually under cultivation on the various streams are made by the division engineer and his deputies of District No. 7 from observations on the ground. In making his map [Defendant's Exhibit 28] he used the figures of District No. 7 because he felt they were more nearly accurate than those of the county assessors, because the figures used by county assessors are solely for assessment purposes and they usually are held down to a minimum. (R. 5160.) Regardless of which figures, however, are standard, his map

shows both acreages. (R. 5161.) The area on the map colored in yellow is a lower elevation than a certain reservoir site on the Dolores River and could be reached by a gravity flow from that proposed reservoir. (R. 5162, 5163.) Most of the land colored in yellow is sagebrush mesa, sloping to the southwest and is red-loam soil. The greater part of this soil is underlain by a strata of sandstone at varying depths in some places, however, coming to the surface. He would say the depth varies from nothing at the surface to ten or twelve feet.

He has had occasion more or less for the last twenty years to study soils and familiarize himself with the duty of water on various types of soil. (R. 5163.) He estimated that a foot and a quarter per acre was ample water for irrigation on these lands. Immediately east of these lands colored yellow there are other lands that are irrigated with similar soil conditions, and it is estimated that these lands use about one and one quarter acre-foot of water per acre. At the time he was working on this project it was considered that there were available from the Dolores River for storage one hundred and eighty-five thousand acre-feet. (R. 5163–5164.) The storage of this water would require a dam two hundred and fifty feet high and it is estimated that there is available in the Dolores River, three hundred and fifty thousand acre-feet of water, it being planned to store only one hundred and eighty-five thousand acre-feet, but it was contemplated to irrigate more

than one hundred and eighty-five thousand acres of land by using the direct flow of the river as well as the storage flow. (R. 5165.) It would be feasible to store the entire three hundred and fifty thousand acre-feet available in the Dolores River.

One and one-quarter acre-feet of water is a pretty low duty in comparison with other portions of the basin, but the character of the soil on the mesas is different from most other portions. After you get further east there is a heavy adobe soil and the river bottom, that is gravelly, requires approximately three acre-feet of water per year.

Practically all of the area colored green on the map requires that much water. (R. 5166.) It was contemplated that for the most economical methods of using the stored water, laterals should be run from the reservoir in a northwesterly direction, to the Colorado line and extending into Utah. At the time the surveys were being made it was estimated that two hundred and eighty thousand acres of land could be economically irrigated under proper distribution in the state of Utah. (R. 5167.) If the reservoir were increased so as to store the full three hundred and fifty thousand acre-feet available in the Dolores River, it would not be possible to irrigate more land, subsequent storage being planned on the mesas themselves.

Aside from the one and one and one-quarter acre-feet of irrigation water required there is a heavy precipitation over a great portion of the area colored yellow, the climatical reports showing fifteen to

twenty inches of annual precipitation. When he states that one acre of land would require one acre-foot of water to irrigate it, he means there should be sufficient water to cover the entire acre of land one foot deep. (R. 5167–5168.) That would be sufficient water for one year's irrigation purposes, the average irrigation period being one hundred and twenty days, beginning early in May and extending through August.

He has been over most of the country within the state of Utah lying south of the San Juan River, and would characterize the soil as being a rich, sandy loam, lying on rolling mesas, and in long draws. He would say the soil is fertile and susceptible of cultivation so as to grow crops thereon. (R. 5168–5169.) Some of this land would be inside and some outside of the Navajo Reservation. He has never made surveys south of the San Juan River but has studied government contour maps, and feels that the water of the San Juan and its tributaries could be stored at some points so as to reach that portion of the country by gravity flow. The country is more or less cut up over which the ditches would be built. (R. 5169–6170.)

There are no irrigation projects now contemplated which extend into Utah on the south side of the San Juan, to his knowledge. (R. 5170–5171.)

Cross-examination (R., Vol. 29, pp. 5171–5173):

In his estimate of five hundred and six thousand acres of irrigable land he deducted roads, ditches, and

other lands that can not be irrigated. (R. 5171.) There is a small amount of the waters of the Dolores River subject to prior claims of persons up in the headwaters of the Dolores. (R. 5172.)

(Pages 156 and 157. Senate Document 142. Sixty-seventh Congress, second session, a report by A. B. Davis, director of Bureau of Reclamation, dated February 4th, 1922, offered in evidence for complainant R., Vol. 29, p. 5173, and are copied in the Record, pages 5174 to 5178.)

"(Pages 156 and 157 of report referred to are as follows:)

"156

"PROBLEMS OF IMPERIAL VALLEY AND VICINITY—DOLORES PROJECT

"Irrigable area, 80,000 acres or more.

"Mean annual temperature, 45°.

"Mean annual precipitation, 14 inches.

"Precipitation during growing season, 7 inches.

"Elevation, 6,000 to 6,500 feet.

"Interval between killing frost, 125 days.

"Transportation, Denver & Rio Grande Railroad, narrow gage; nearest station, Dolores, 20 to 60 miles.

"*Irrigation plan.*—The Dolores reservoir is to be built on Dolores River just below mouth of Beaver Creek, about 10 miles downstream from town of Dolores. Present water level is to be raised 230 feet and diversion to be made 173 feet above stream bed, leaving 120,000 acre-feet of active storage. The canal will follow the south side of the canyon for

14 miles and pass with a 4,800-foot tunnel to the headwaters of Montezuma Creek in the San Juan Basin. From this point the main canal branches to the south and northwest. The lands to be irrigated consist of mesas sloping toward the San Juan River and separated by deeply cut drainage channels. The canal from the reservoir to the point where the irrigable lands are reached will be built through a very difficult country, with a large amount of flume and tunnel work. After passing the San Juan divide, the canal system will not be difficult of construction.

"*Duty of water.*—Irrigation diversions of a 2 acre-feet per acre will probably prove sufficient, as much of the area has recently been successfully dry-farmed.

"*Water supply.*—All water will be derived from the Dolores River. The average recorded discharge at Dolores is 291,000 acre-feet annually, which when adjusted for normal years by comparison with Animas River at Durango would be increased to 319,000 acre-feet. Inflow from Beaver Creek and other drainage to the dam site would add 20,000 acre-feet. On the basis of an average year, the relation of water supply and demand for an 80,000-acre development would be as follows:

"Water supply and irrigation requirements. (Acre-feet.)

Redirect examination (R., Vol. 29, pp. 5178-5179):

He is familiar with the filings on water on the Dolores River within the state of Colorado, and in

giving his statement he means water available and subject to appropriation. (R. 5178–5179.)

Month	Discharge of Dolores at reservoir	Prior rights of Montezuma project	Balance for Dolores project	Demand for Dolores project	Draft on storage
April	48,000	8,000	40,000	13,000	
May	104,000	20,000	84,000	32,000	
June	91,000	30,000	61,000	48,000	
July	29,000	20,000	9,000	32,000	23,000
August	13,000	15,000		24,000	24,000
September	8,000	7,000	1,000	11,000	10,000
October–March	46,000		46,000		
Total	339,000	100,000	241,000	160,000	57,000

"With 120,000 acre-feet of storage available there is sufficient holdover capacity to tide the project over short years, excepting only where these occur in a series.

PROBLEMS OF IMPERIAL VALLEY AND VICINITY

For a short year like 1900, preceded by a shorter year when no holdover is available, conditions would be as follows:

		Acre-feet
Inflow, October to May, inclusive		132,000
Diversions by Montezuma project	40,000	
Diversions by Dolores project	45,000	
		85,000
Storage June 1		47,000
River discharge June–September, inclusive	60,000	
Diversions by Montezuma project	42,000	
Balance for Dolores project		18,000
Total for Dolores project		65,000
Total per acre, Dolores project		0.81

"While this amount is relatively low, it is, however, sufficient together with precipitation to prevent total crop losses, and considering that such years do not occur frequently, the project may be expected to develop to this point.

"*Storage.*—The relation of storage required to project area has been outlined. Additional storage may be available above the Dolores site, though no data are at hand. The Dolores reservoir, as planned, backs water to the Montezuma project dam, and additional storage by raising the reservoir could be accomplished only at considerable cost in reconstruction of the diversion system for that project. Lowering the outlet in Dolores reservoir would increase storage, but would also increase cost for the main canal by lowering the summit grade of the San Juan divide.

"*Conclusion.*—The acreage available for this project is much larger than the water supply will care for and construction will depend wholly on unit costs, as the cost of the main features of the project will vary but little with considerable variation in acreage. Such unfavorable features of this project as its transportation facilities, large initial investment required, and probably high cost per acre will probably deter development for a long time."

HENRY GRIMM

For Defendant

(Record, vol. 29, pp. 5180–5187)

Henry Grimm, of Moab, Utah, is a blacksmith by trade, and has lived in Moab about thirty-six years. He has had a little experience on the Colorado River in August, 1898, having taken a trip in a boat belonging to another gentleman, from where the Moab

bridge now is, up the river to a point about two miles above Castle Creek.

The boat, as he recalls, was about twenty-four feet long, five feet wide, flat bottom, with a light draft, and carried on the trip a load of about five hundred pounds. The boat was propelled with oars and it was unnecessary for them to tow at all in that distance. They were able to row through the rapid stretch in Nigger Bill and through the rapids below Castle Creek, going upstream in these stretches very nicely. (R. 5180–5182.) Both men rowed going upstream.

They came back down on a raft of lumber but it contained about six thousand feet, the boat being tied to the back of the raft. In the swift rapid at the mouth of Castle Creek they were hung up on a rock for about fifteen minutes but soon released the raft and went on down the river. (R. 5183.) Aside from this little difficulty with the rock, they had no difficulties whatever going up or down stream. There was one place down at Nigger Bill where there is a shelf of rock that the water runs over that our raft struck a little bump of that shelf; he just stepped off of it into the water, took a two-by-four and raised it; it went right on over it, and away it went. He does not know whether there was or not any deeper section of the channel at that point where they got stuck; apparently the water runs over a shelf there. (R. 5184.)

He owned a farm on the river about two miles below Moab and used a boat to go up and down the river from his farm to town and back. He continued operating the blacksmith shop in Moab but lived at the farm and made the round trip back and forth on the river. Supplies for the farm were hauled from Moab down to the river and boated down to the farm, the farm being on the opposite side of the river from Moab. A boat was kept there for the purpose of crossing back and forth and boating up and down the river. (R. 5184–5185.)

He remembers seeing lumber hauled up to Moab from the river but the only raft he ever saw on the river was the one that he brought down.

Montgomery, a carpenter by trade, had a shop near his [Grimm's] blacksmith shop and during that time he saw lumber that was hauled from the river up to the carpenter shop, and this lumber that was brought up from the river could have got there only by raft. (R. 5185–5186.)

FRANCIS M. SHAFER

For Defendant

(R., Vol. 30, pp. 5192–5203)

He resides at Moab, Grand County, Utah, where he has been postmaster for the past twelve years. He originally came from Nebraska, stayed in Colorado a short time, and came to Utah about the 12th or 13th of November, 1888.

He first built a raft at the mouth of Cisco Wash, about thirty miles above Moab, on the Colorado River. This raft was about twelve feet long and six or seven feet wide, and he was accompanied by an older brother. (R. 5192–5193.)

He had had a little previous boating experience on the Ohio River. He is sixty-one years old.

After they had built the raft they had a chest of carpenter tools, small trunks, their bedding, an eight-by-ten tent, material for a placer rocker, and groceries. He would say their load was at least five hundred pounds, and his brother and he rode the raft down the river. Their destination was the mouth of Castle Creek, just above Moab, fifteen or twenty miles. Their plan was to go into the country and do some placer mining. On the trip down the river, when they arrived at the mouth of Castle Creek, it was covered with trees and brush, and they did not observe it was the mouth of the creek, and passed by, and went to a point known as Nigger Bill Canyon, three or four miles above Moab. By then he had satisfied himself that he had passed the place he was going to, and they went ashore and tied the raft up, and walked into the little town of Moab. (R. 5194–5196.) They stayed there overnight, and the next morning went back to the raft, and went back up the river to the mouth of Castle Creek, and stayed there overnight. The next morning they found a river boat in the willows. He believes this boat was about fourteen or fifteen feet long,

and four feet wide, and they put the boat in the river and went to the mouth of Nigger Bill Canyon. At this point they transferred the cargo from the raft into the boat, and took the boat back up the river. With the exception of the two rapids, one just below Castle Creek, and another at the mouth of Salt Wash, they rowed the boat with one set of oars in the quiet water, as far as they could on to the rapids, and then used a fifteen or twenty foot tow line and a pike pole, and one of them would pull the boat along the shore through the rapids, and the other held the boat with the pike pole to keep it from interfering with the shore. He does not know what distance they towed the boat, but the rapids were not very long. He believes it was not more than three or four hundred feet altogether, and the balance of the distance he rowed.

He did not have any trouble with the raft, as he discovered after it was launched at the mouth of Cisco Wash in passing the first rapids, that there was always a current of water in the center where the main river was running down, that was always able to carry the raft, and when they came to a rapids, would run through the current and never experience any trouble in going down with the raft. (R. 5196–5197.) In coming back with the boat they had to keep close to the shore when they came to the rapids, but they were not so bad but that one of them could not pull the boat up while the other would hold it with the pike pole. He did

not have any trouble with the boat, and did not have any trouble in getting aground, and always found plenty of water to run in, both in going down the river with the raft and coming up with the boat. He believes this was the 12th of November, at least he is sure it was the early part of November. (R. 5197–5198.) He would not consider it a high stage of water, as the high stage is in June or July. He never measured the depth of the water, but on one end of the raft they had an oar-lock, and used a steering oar perhaps ten feet long. In passing over the rapids he used this to steer the raft, and never experienced any trouble. He would think the water was at least two feet deep at any point of the rapids. (R. 5199.) He believes the boat, with the 500 pounds of cargo, would draw at least a foot of water or more. (R. 5199–5200.)

Cross-examination (R., Vol. 30, 5200–5203):

After that he continued to live in Moab, and Thompson was the shipping point for freight. Before the coming of the automobile he always figured on a full day in making the trip from Thompson to Moab on a passenger vehicle, and with a freight outfit figured on the better part of two days to make the trip. He does not know how much time it would take to Greenriver. He has never made that trip.

When he discovered he surely had made a mistake in landing at the mouth of Castle Creek he ran ashore and he did not want to go any further

with the raft because of the load, as his destination was the mouth of Castle Creek. (R. 5200–5201.)

The reason he did not go on down with the raft to Moab and come back on the raft the next day, was the great amount of work in getting the cargo back up the river, and it was easier walking.

He came to the point on the Colorado River where he built the raft, from Grand Junction by team, and the team came to this point because it was a place where he could get material from a large bottom there. One of the men with them was well acquainted with the country and knew where the material was for making the raft. (R. 5202–5203.)

When he arrived at Moab he does not believe there were over 800 people in the town, and at present he believes there must be close to 1,000 or 1,100 people. (R. 5203.)

HENRY E. BLAKE

For Defendant

(R., vol. 30, pp. 5204–5229)

He resides in Monticello, San Juan County, Utah; and his full name is Henry Elwyn Blake. He is sixty years old. At one time he has resided both at Greenriver and Moab. He lived first at Greenriver, and first went there in the late spring of 1909. (R.. 5204.) He came from New Mexico into the San Juan country, mining, in the winter

of 1906, but he lived in Denver and operated from that point through Moab until he took up his residence in Greenriver. At the present time he operates a newspaper at Monticello. His purpose in coming to Greenriver was to launch a boat on the Green River and investigate the possibilities of freight traffic between there and Moab on the Colorado River.

He built this boat in the spring of 1909, and it was 24 feet long by 6-foot beam, with flat bottom. (R. 5204–5205.) It had a 14-horsepower internal-combustion engine, and was driven by a submerged propeller. He made several trips on the Green River with the boat that year. It was launched about the middle of June, and on its first trip he went to Moab, accompanied by Captain F. C. Roff, of Iowa; H. B. Johnson, whom he brought from Denver to help build the boat and install the engine, and A. I. Anderson, who went along with them as assistant, as far as his [Anderson's] ranch on the lower Green River.

Another gentleman and Anderson got off the boat at Anderson's ranch, and aside from Anderson there was not any one in the party who had ever made the trip before, as far as he knows. (R. 5206.) Captain F. C. Roff piloted the boat. They encountered no obstruction whatever, as far as the river was concerned, and got through with practically no delay. When they got down to the junction of the two rivers they went three miles down the Colo-

rado to where in high water the current struck a huge boulder and threw a wave dike across the river. They did not run below that, and walked the balance of the way down to a point that came out just north of Powell Canyon and observed the cataracts below for the first time. They then came back to the boat. (R. 5207.)

The current at the Slide looked pretty swift for the speed of the boat, and there was a side current coming over the Slide at the north shore, and Captain F. C. Roff decided it would be less trouble to go through that. They probably were five minutes going through the hundred yards, and the speed of the boat and the speed of the river being so close together it was the same as if they were just leisurely going through, but he did not tow up. He never towed on the river. (R. 5208.) He never at any time had to do any towing with that boat on that or any subsequent trip he made with it. There were no difficulties on that trip and they returned at the extreme crest of the high water. This was one of the highest water seasons in years. They went up the Green River during that high-water period, and it was so high and the drift was so heavy that they had to follow the sides of the channel to avoid drifting, but on that trip they did not get stuck on any sand bars. (R. 5208–5209.) It took about five hours going down the Colorado River from Moab to the junction, and they went up the

Green River at the rate of about five miles an hour, as he recollects.

Going down the Green and up the Colorado they were eight hours traveling time from Greenriver to the Townsite Bottom, and he recalls it was about two and a half hours from Townsite Bottom to the junction of the rivers, taking advantage of the full speed of the current. By traveling time he means while the boat was in operation, and it takes eight hours running time from the junction of the river to Moab going upstream. (R. 5209–5210.) At that time there were two streams at the Slide, and he took the smaller one.

The next trip in that boat was in July, and was made to the Townsite Bottom, where Mr. Anderson resided with his daughter. On this first trip they started from the town of Greenriver, and returned to the same place.

On the trip he took to Townsite Bottom, he had a barrel of gasoline that weighed about four hundred-fifty pounds, and he does not know just how many supplies, provisions, and bedding; but he took a quantity of supplies for Mr. Anderson's camp. (R. 5210–5211.)

In September of that year he took an excursion party to Moab and return. He does not recall any particular trouble at all. He might have run on to the point or tail of a bar, and he remembers in attempting to go to shore of having run into a slight bar. On the trip to Townsite Bottom, Miss

Anderson accompanied him. She is a daughter of A. I. Anderson. He believes Anderson was attempting to establish a small farm in connection with oil development they were trying to promote west of the river. (R. 5212.)

The September trip he made for certain agreed charges, and during August of this same year, he constructed a boat called the *Utah*, a tunnel boat; and the September trip was made on that boat. The name of the first boat was the *Ida B.* and he took the engine out of the *Ida B.* and put it in the *Utah*. The *Ida B.* had a draft of 22 inches, approximately, under normal load, and the *Utah* had a draft of 18 inches under normal load.

Coming back from Moab on the September trip he loaded about 1,000 pounds of peaches. When he loaded the peaches they were riper than was the usual custom in picking peaches for shipment. He found this out afterwards. When he arrived at Greenriver they were almost perfect. They had ripened a little, but they were not overly ripe, and were all salable. (R. 5213–5214.) On this trip he does not recall any difficulties or delays until he got to the mouth of Indian Creek. He had a slow time going through the Slide and had to follow the eddy waters, and he ran on to a submerged rock and had to throw the nose of his boat in the stream to let the current pull it off. Then it turned around and went back, and he ran across and struck the eddy water on the other side, but it did not damage

his boat any. There was no trouble at Indian Creek; he attempted to follow the wrong way of the river, where the normal channel was, and ran up about a quarter of a mile and found himself in dead water. He knew the channel did not run there, so he turned around and went back to where he saw the channel cutting over on the north bank, and turned in there and went on, but did not run into anything. When he came up the other channel he did not have any difficulty, just the usual current of the river at practically low-water stage.

In November of that same year he accompanied Mr. Wimmer with a party of boosters from Salt Lake City and they had an accident when they first started out. Mr. Wimmer's boat was at Wimmer's ranch, and they took the supplies down in a wagon, and left the passengers. He believes there were twelve or fourteen passengers for him to bring down that evening on his boat. The loaded boat with passengers obstructed his view considerably, and as he went through the riffle just below the railroad bridge he struck a submerged rock with the skag iron on his boat, and jerked a hole through the bottom of the boat about five inches in diameter. He had a load of cotton batting that he used for calking that he jammed in the hole, and got to shore without anybody getting wet, and it took him two days to repair the boat. (R. 5214–5216.) After he repaired the boat he went on, and completed the trip. He believes it was the third

morning from the time he had the trouble until he landed at Wimmer's Ranch.

In going around to Moab he had seven or eight passengers in his boat and most of the supplies. He had no special trouble that he remembers at all on the trip, and does not especially recall any delays from any cause. (R. 5217.) The passengers left at Moab and the crew came back. They took their time, hunting along the river. They left Wimmer's ranch after dinner, and camped, he believes, at Echo Bottom, and the next night camped at the junction of the river, and going up to Moab made one night's camp, and reached Moab between twelve and one o'clock in the afternoon.

He made one special trip to the Wimmer Ranch during the summer, with an excursion party. This trip was for compensation. (R. 5218.)

During the summer he took several picnic parties up the river from Greenriver for a few miles. He does not recall just the number, but there were several. He does not recall other shorter trips down the river except those he has mentioned. The trip to Moab following the accident to his boat was for compensation.

In 1910 he started work with the pumping plants, and had no further experience to amount to anything on the river with his own boats. He made one trip in 1914 with the Wimmer boat to the junction.

In the course of these trips, and on the occasion when he stopped to hunt on his way back from Moab, the channel had gone back to its natural winter channel, and he does not recall any trouble in landing. The silt bars that were exposed were so hard he could run up to them and camp on them, and he has made landings when there was mud and silt at the edge of the river, but he only recalls one special instance when he wanted to stop at Fort Bottom, and he ran into the point of a high-water silt bar about one hundred feet from the bank, with only about four inches of water over it. He caught the nose of the boat on it but kept the engine running and sucked the mud from under the boat, and went on shore. He did this purposely so he could land. (R. 5219–5220.) It is his experience that the silt bars that have never been exposed to the atmosphere, and were just deposited in absolutely dead water, that he could create a current with revolutions of his propeller, and suck it out and have channel enough to get to shore in the boat, and would have to back out in the morning.

He does not think the channel changes so much from high water, but a projection will change the current, and he could not say the channel changed, because in low water it goes back anyway. But the current does change at points where a projection will change it. (R. 5220–5221.)

He originally went to Greenriver with the thought in mind of operating freight boats on the

Green and Colorado Rivers. At that time he had in mind boats up to 100 feet, or a minimum capacity of a carload for wholesale freight shipments. He believes he instigated the endeavor to get the Government to improve the navigation of the rivers so he could run the big boats without obstruction, and was unsuccessful in his endeavor to get the Government to spend the money. (R. 5221–5222.)

Cross-examination (R., Vol. 30, 5222–5227):

The last time he saw the *Ida B.* it was standing on its head just below the Wimmer ranch, with about three feet of its tail sticking out of the bar. (R. 5222.) By the time the *Ida B.* was in the river he was out over $1,500 that he had drawn out of the bank, and this included the money he spent and the time he started on the project of buying the engine until the boat was launched. The *Utah* probably cost $75 to $100 for the material and labor on it, and he reinstalled the engine from the *Ida B.* in the *Utah*. The *Utah* was left to rot on the shore of the Wilson ranch, about five miles above Greenriver; that is, the hull of it. It was not a wreck, but was abandoned. (R. 5223–5224.)

He recognized the boat in photograph No. 11 of Compl. Exh. No. 77 as one of his boats that was never named. The boat was launched at Moab in 1907 and was used in investigating trips around the river up and down from Moab to determine the practicability of the boat. (R. 5224.)

He had operated south of Moab, mining, and went through Moab on dozens and dozens of trips. The boat was built at Greenriver instead of Moab and the year was 1927 instead of 1907. It cost him between three and four hundred dollars to build a boat.

He had the most difficulty in operating his boats between Greenriver bridge, Utah, and the Wimmer Ranch. He does not recall any particular riffle or ledge that gave him the most trouble, but he always considered the riffle just below the Greenriver bridge as the most dangerous to navigation in real low water. (R. 5225.)

During his experience south of the San Rafael and around to Moab in the operation of the boats he encountered sand bars. (R. 5225–5226.) He never got right on any sand bars during the trips, but when he first got on the bar at Woodruff, Mr. Johnson got out of the boat with an oar to see how far they got on to the bar, with the idea of just backing off and making another landing. This was while he was trying to make a landing. (R. 5226.)

In going downstream he got pocketed once below Fort Bottom while he was running a race with the *Marguerite*. He took another channel expecting it would break through but it did not and he had to turn around. He carried nothing but oars for the purpose of getting off the sand bars, and always carried oars in case of engine trouble.

Woodruff is what is called Foot Bottom, some six or eight miles above Fort Bottom, and about sixty miles down the river. It was a large bottom that was squatted on by a surveyor by the name of Robert Foot. He built a two-story frame house and expected to make a fruit ranch out of the bottom. He rafted the lumber down from Greenriver. He is not certain whether it was rafted down from Greenriver to the ranch, but it was rafted down the river. (R. 5227.)

Redirect examination (R., Vol. 30, 5228–5229):

He believes Moab is recognized as one of the earliest growing seasons of any section of the State. Regarding the seasons of ripening of products, he knows Greenriver, Moab, Monticello, and Blanding, San Juan County, and the season for the ripening of fruits and vegetables in Moab is practically the same as Greenriver. It is possibly a little earlier in Moab, and Moab is better protected from winds than Greenriver. Moab is a month earlier than Monticello. (R. 5228–5229.)

Further examination (R., Vol. 30, 5229):

Mr. Henry E. Blake, jr., who has testified in the case is his son, and when he was a small boy he went with him on the September trip in 1909. (R. 5229.)

ALBERT I. ANDERSON

For Defendant

(Record, vol. 30, pp. 5230–5249)

He resides at Oakland, California; and is seventy-four years old.

At one time he resided at Greenriver, first going there in 1908. He went into the country practically to Elaterite Basin, eighteen or twenty miles south and west of the river, to see about oil. (R. 5230.) In getting down to this section of the country he went down with two rowboats, and left Greenriver between the first and the middle of December, 1908. There were four in the party. That was the first of his boating.

When he first went into the oil field he went in by pack from Torrey, Utah. That is, he had been into the oil field overland prior to the boating trip. On the boat trip they took two boats, loaded with about nine hundred pounds each, and went to the mouth of Miller's Canyon, which is located right at the upper end of Townsite bottoms. (R. 5231.) After they arrived at the upper end of Townsite bottoms, or the mouth of Miller's Canyon, Tom Baker met them with a pack outfit of four or five horses. Tom Baker had come from Torrey on a trail, and the point they desired to reach was about eighteen or twenty miles from the mouth of Miller's Canyon. (R. 5232.) They pulled the boats out of the water entirely, and took the pack outfit and saddle horses, and rode to their destination. The

supplies were taken from the boat with pack outfit. He believes the boats would draw loaded about ten inches, possibly twelve inches. They were about fourteen feet long, with a three-foot beam.

After he left the point of destination he returned to Salt Lake City, and later returned to Greenriver in January. He stayed there until the first of January, locating land, and when he got through, went out by the way of Torrey and Richfield, and back to Salt Lake. (R. 5232–5233.) The land they were locating was in Elaterite Basin.

The next boat trip he made was with Bill Coyle, and a party. They went down in another rowboat and had nine hundred to one thousand pounds of load. (R. 5234.) This trip was along in March, 1909, and he later went back up the river with the boat. There was no one with him, and he would row and tow upstream. He had about one hundred feet of rope that he took along for that purpose. (R. 5235.)

In the latter part of April he took a trip with Mr. Oppenheimer on the motor boat the *Paddy Ross*. They went down as far as what is called Sheep Trail. They went down the river to meet Major Leeds, Mr. Easton, and Ross Wheeler at the junction, but had some engine trouble and met them about ten miles above Sheep Trail. Leeds, Easton, and Wheeler had rowed down the Colorado River and were coming up [the Green] when they met them. They were in a rowboat, and they all re-

turned from that point back up to Greenriver, Utah. He believes it took them about three days. The engine trouble Mr. Oppenheimer had in his boat was something about his valves. He made a new one out of a pewter spoon. (R. 5235-5236.)

He recalls a trip he made with Mr. Blake in the *Ida B*, and his recollection would be substantially the same as Mr. Blake testified to. On one of the trips with Mr. Blake, they towed one of the boats back up to Greenriver. This was also done when he was with Mr. Oppenheimer. He recalls making a trip with Mr. Blake on the *Utah*, and his recollection of that would be practically the same as Mr. Blake detailed in his testimony. The trip on the *Utah* which he made with Mr. Blake was first down to Townsite. (R. 5237.)

He has seen Mr. Blake take excursion parties on the Green River, and has seen him with an excursion party at Moab. There must have been twenty-five or thirty men with him. This was just a short trip up the river, from where the bridge was then to Moab. It was about two miles, and there were a lot of children on the boat.

In the latter part of October, 1909, he recalls making a trip from Greenriver to Moab and return, on the *Paddy Ross*, with the Hughes party. (R. 5238.) This was the latter part of October or the first of November, in 1909.

In 1910 he made a trip from Greenriver, Utah, to Townsite Bottoms in a rowboat. He was taking

supplies down to Townsite, where he was stopping at that time.

He retained his interests in the oil section down there for a few years. There are large deposits of oil sand in the Elaterite Basin. The oil is practically oozing out of the ground in places. There are sands there that are one hundred feet vertical. He doesn't know how much deeper it went, and it covers a number of miles. (R. 5239.) The Elaterite Basin is accessible from either Hanksville or Greenriver. He would say that you could drive to French's Seep, about eight miles from the basin. He went in that far; came in with a buckboard, and brought six horses with him.

He doesn't know of any wells that have been drilled, although they have drilled up on French's Seep; but there are some well-marked domes there. (R. 5240–5241.)

There are several croppings of oil shales in there; but he never made any tests, and has no personal knowledge of any tests having been made as to the oil content. He doesn't believe that any work has been done to determine their extent. (R. 5241.)

There was one trip on which he went back from Townsite Bottoms to Greenriver with Ross Wheeler, in a boat. He also went up the Green River in a rowboat from Townsite Bottoms, with Ed Prothero. He never took a trip with Mr. Wolverton in the *Wilmont*, but he has taken a trip with him in the *Navajo*. That was a surveying trip for

Colonel Tasker, and they went down about one hundred and ten miles below Greenriver to the Tuxedo Bottoms.

He recalls going down the river, and being on it for some time in August, 1914, with a government party. This was not the Hughes party, however; it was for the drilling. (R. 5242.) Leeds went first and Hughes later, and they were sounding the river. This was in 1909. While the drilling operations were in progress in 1914 he had a boat of his own down there. (R. 5243.) He was in the Henry Mountains the fore part of the season, and they wanted his boat so he let them have it; Ross ran it. That was on the survey party, but when they went down to drill he went with his boat and operated it while he was down there.

He made several trips to Moab with his boat. He took the surveyors to Moab, up and down the Colorado River. He doesn't remember the man Steele, who posed as a geological survey man. (R. 5244.)

The time of year that he made the trips to and from Moab, while he was with the 1914 government party, was from the latter part of August or first of September up to the first of November. He believes they finished the work about the first of November, and he was with the party when the drill and equipment went up the river to Greenriver, Utah. He rode in his launch. There were two of them, and the two launches each shoved a

barge about eight feet wide and thirty-four feet long, up to the Wimmer ranch. (R. 5245.)

He has never had any trouble in his experiences on the Green and Colorado Rivers, and the nearest he ever came to getting on a sand bar was in coming down with Mr. Richardson and Mr. LaRue, when they just touched a bar, but went right on.

He doesn't believe a man familiar with the river, and keeping a reasonable lookout, need be afraid of encountering obstructions or delays on either the Green or the Colorado River, with boats the character of which he has operated and seen operated on the river. (R. 5245–5246.)

Cross-examination (R., Vol. 30, pp. 5247–5248):

The last time he was in the Green River country was about seven years ago, and he doesn't believe he has been down in the Elaterite Basin since 1911. He never had any drilling equipment, or did any drilling down there. He didn't homestead the place he had down on the Green River.

He went down with that intention, but it wasn't surveyed, and he stayed there a part of two or three seasons, and then abandoned it. He just had tents, and planted some stuff there. (R. 5247–5248.)

Redirect examination (R., Vol. 30, pp. 5248–5249):

He planted some sugarcane for one thing, and within sixty days it grew ten feet, eight inches high. He put a stake down and measured it, and it grew

three inches a day. He raised onions, lettuce, turnips, and carrots, and everything planted there was wonderful. He believes these bottoms were withdrawn for the government about 1912. He had abandoned his place down there at that time, and if anything had turned up he would have gone back, but he couldn't stay down there himself, and his boys didn't care to. He has horses down there. (R. 5248–5249.)

WILLIAM COOLEY

For Defendant

(Record, vol. 30, pp. 5249–5260)

He resides at Castle Valley, Utah, and is 72 years old. At one time he knew a man by the name of Branson, who was engaged in the sawmill business. He worked for him for several years as a sawyer. He was working for Branson when he was cutting timber on Castle Creek, and also at Fisher Point. He believes that Branson was cutting timber on Castle Creek in September, 1897, and left there in May, 1898.

He knows of his own knowledge that Branson did some rafting, and he helped him down the river with one raft about the 20th of October, another one about the 20th of November, 1897. (R. 5249–5250.) He is able to fix these dates as he came into the LaSal Mountains in the spring of 1897, prospecting, and went to work near the 20th of September for him as sawyer. The trips were about a month

apart and he was in Moab Thanksgiving Day, 1897. He thinks possibly there was a raft before he went there. (R. 5250–5251.)

He knows of other lumber being hauled away during the first season of cutting on Castle Creek towards the river. At the time he took a raft down he went on horseback himself, and followed the team down to the river. The raft began at the point where the road strikes the river coming from Castle Valley, about a mile above the mouth of Castle Creek.

He worked at Fisher Point in the fall of 1902 and was there probably two or three months. He worked for him again in the fall of 1903. (R. 5251–5252.)

He was not there in the fall of 1904, but he went further up the river. He went down with other rafts, two in 1897 and one in 1898, another one in 1902 and one in 1903. During 1902 and 1903 there was lumber hauled from the mill down the road that leads to Castle Creek during other periods than those when he went down and accompanied the raft. There were about two teams hauling from the mill and they loaded every other day for the river. (R. 5253.)

After he left Mr. Branson's employ in 1903 or 1904, he settled on the river five and a half miles east of Cisco, and he went down from his ranch at Cisco to Moab once or twice a year during the four years he was there. At that time there was

a road, and is yet, that follows the river from that point to Moab, and passes probably within 300 feet of where he put the lumber in the river.

Mr. Branson had a house and a corral there on the river where the rafting began. (R. 5254.) He would stay at this place almost every time he went through, and would see lumber there almost every time he passed; sometimes a big pile, but he saw lumber there in varying amounts, from nothing to as high as 20 or 25 thousand feet piled on the bank. This was during the four-year period that he lived above there. Almost every time he passed he saw lumber in the yard. (R. 5255.) He saw teams come in there in the evening from the mountains and unload. On the raft he accompanied he never encountered any difficulty, and at times if the water was low they would probably take ten or fourteen thousand feet, and if it was high with a good stage of water they would take twenty or twenty-five thousand feet of lumber. All of the rafts were in three sections, and the lumber was ordinarily from twelve to twenty-four feet. (R. 5256.) The layers would be from 15″ to 24″ deep, and would be from twelve to sixteen feet wide. They never made them any wider than that. Each section would be from twelve to sixteen feet wide and twenty to twenty-four feet long, and the three units would be sometimes forty-eight and sometimes fifty-four feet long; the entire length of the three sec-

tions would depend upon the length of the lumber they had to haul. (R. 5257.)

Cross-examination (R., Vol. 30, 5258–5260):

The running time from Castle Creek to Moab would be all the way from two and a half to three hours in the spring when the river was flush. At low water he has taken as high as ten hours to make the trip, and the slow water would cause the delay, as there are stretches of water between Castle Creek and Moab where the river would probably not run over a mile or a mile and a half an hour at low water. All the lumber was long-leaf yellow pine, and would grade around No. 2 Common, and he believes that Mr. Branson got about $22.00 a thousand in Moab for the lumber. (R. 5258.) The price would be approximately the same in 1902 and 1903. When he made the raft trips down there would be just two of them. They never had over two men on a raft at any time he went.

There was a road up the river, and he would go back with team up the river to the mill.

In 1897 and 1898 he went over what was called Wilson Mesa; would climp out of Moab to a point about 7,000 feet, and would drop over the hill into Castle Valley. There was a road across there. It was not exactly a road, but he got over it with a team. He would use Mr. Branson's team. (R. 5259.)

DAVE JOHNSON

For Defendant

(Record, vol. 30, pp. 5260-5275)

He resides at Moab, Utah, and is engaged in the hotel business. At one time he was in the employ of the Moab Garage Company, and worked on the large boat called *The Barge* belonging to that company. He worked for possibly a seven-month consecutive period, and he did not miss any shifts during that time. He first commenced to work on *The Barge* some time in December, 1925, and continued until somewhere around June, 1926. This was his first experience on the Colorado River. During this period they hauled down the rig and material to rebuild the one that burned down at Shafer No. 1, and the same for Shafer No. 2 and camp houses. (R. 5261.) There had not been any well burned down at No. 2 but they hauled similar equipment; hauled to the Snowden-McSweeney dock across the river from No. 1. They would try to average about eighteen or twenty tons to the load, but to the best of his recollection they have hauled as high as 22 tons. They have taken down full barge loads of coal, eighteen or twenty tons at one time. (R. 5261-5262.)

They made more than one trip with coal as freight. Virgil Baldwin had charge of the boat during the period he worked on it. Virgil Baldwin ordinarily piloted the boat going down, and he would pilot it coming up. The cargo was unloaded

with a gasoline hoist and crane. This was used in unloading all of the heavy freight. The freight hauled up the river would be bent tools, such as stems and bits, and they hauled crude oil on two or three different times. They would haul from eight to ten tons, as an approximate guess. (R. 5263.) He believes they brought up sixteen barrels of crude oil on one trip, and a barrel would weigh from 400 to 450 pounds. During the drilling operations there were times when there would be considerable amount of freight brought up in the way of bent tools and various things. During his period of seven months on *The Barge* there was a portion of the time that there was high water, and his best recollection is that the river commenced to rise in March, and holds up until about the 20th of May, he believes, and from the 20th of May to the 10th of June they would have the highest water. There would be scarcely any difficulty in high water in the operation of *The Barge* up and down stream. Going upstream in high water they would follow what they call dead water along the bank, and that would be the shallower water. During high water the sand bars were all covered, mostly. In going upstream there was not much difficulty from sand bars, as all they had to do was to reverse the engine and the current would help them off as a rule. (R. 5264–5265.)

During the operation of the big boat he did some night traveling, and when making two round trips

every three days there would be one of the nights that he would have to travel late, or camped out along the river, and they would generally travel pretty late that night. They have left from points down the river and started upstream with the intention of tying up on the stream overnight, and concluded the journey the next morning. They would do this most of the time. There were two or three times on moonlight nights when they would get into the dock as late as nine-thirty. They would have delays at times when operating the big barge, and the delays were ordinarily in low water. (R. 5266–5267.) On the trips he made during this seven-month period, he would say that there would be half of them when they were not delayed on account of not getting up and down the river because of obstructions or obstacles in the way of sand bars.

There is a point between Mill Creek Wash and Kane Spring Wash where they generally met with difficulties when they would have them, and another place that he calls the Canyon Wash, about a mile and a half below the upper dock, where they would get hung up on sand bars. At this last-mentioned place, he remembers but two times; each time they had trouble was after a big flood that came in from the north side of the river, and it would seem like the channel was kind of clogged up there, and the point would run out into the river a little farther than it had been before; the sand would extend farther out. As a rule, if they

had trouble, and they took a little time to get out in a small boat to look around, they would always find the channel and go right on through. The channel would be large enough to pass without impeding the progress of the boat. When they did not find the channel they would be hung up. (R. 5267–5269.)

He is not positive, but he does not think that they were ever hung up over two or three hours at any one place, and the periods of time would vary. As he remembers, it was about twice when they failed to reach Moab, when they had left a point down the river with the intention of going clear through. The next morning they would just look around a little bit and go right through, either by floating or by finding the channel. (R. 5270.)

During that period of time they transported horses, and Defendant's Exhibit No. 29 shows the big barge with horses on it. Defendant's Exhibit No. 30 shows one of the oil rigs. He believes it is No. 2. A few times they had occasion to haul camp supplies for cattle outfits down the river, and the barge was used for carrying the outfits of cattlemen from one side of the stream to the other.

The main place they hauled grain was about half way between No. 1 and No. 2. (R. 5270–5271.)

There were occasions when they took trips down the river from Moab that the boat would be kept down for several days, when they would be hauling casing from No. 1 to No. 2, and they would haul cot-

tonwood logs from the bank of the river to the Snowden-McSweeney dock, and when they took parties of geologists or other parties down the river they would sometimes remain down there for three or four days. When they would take down geologists they generally ate their meals on the boat, and would use that as their headquarters; would take hiking trips over the country on both sides of the river and come back to the boat at night, and the next morning they might move them down to the next well site or wherever they wanted to land, and on these occasions the boat would be away from Moab for two or three days at a time.

During the seven months he has been down the river close to fifty miles, down to Lockhart. He does not remember whether he went down to Indian Creek with a big barge or not, but he figures the farthest point he ever went down the river was between fifty and sixty miles from Moab. (R. 5171–5173.)

He did not have any trouble with river water while he was operating the boat, as far as the engine on the boat was concerned. The engine had a radiator and they would use river water, dip it right up out of the river, and put it in a tank that was connected with the radiator. (R. 5274.) They had a practical and effective cooling system on the boat. (R. 5274–5275.)

ISAAC W. STARK

For Defendant

(Record, vol. 30, pp. 5275–5283)

He resides at Buhl, Idaho; is forty-seven years old, and first went to the section of the country near Greenriver, Utah, in 1900. (R. 5275.)

In 1905 he assisted Mr. Wolverton in making alterations on the boat *Wilmont*, took the stern wheel off and put on side wheelers, and he took trips with Mr. Wolverton on the boat; he went to Moab and from Wolverton's ranch to Greenriver and return, and he made lots of rowboat trips both up and down the river. These were short trips. He did some work on Wolverton's ranch, but he prospected mostly up and down the canyon.

He has been on the *Cliff Dweller*, and made trips above the bridge. He knows the name they put on it was the *Cliff Dweller*, and he has photographs of the boat and himself standing on it. For the trip to Moab, they named the boat *The City of Moab*, and after that trip it was remodeled and renamed the *Cliff Dweller*. (R. 5276–5277.)

In a rowboat with a man sitting with his back to the current, he sometimes would nose into a sand bar. He would sometimes nose into a sand bar with his rowboats; with the *Wilmont*, he only recalls one time he struck a sand bar and they were some minutes poling off; but he didn't have to get out of the boat, and neither did Mr. Wolverton, who was with him.

Picture No. 1, in Defendant's Exhibit No. 31, is the *Tom Fair* ferry boat above the bridge at Greenriver, Utah. (R. 5277–5278.) Picture No. 2 is the same boat. Picture No. 3 is the day of the launching of the *Cliff Dweller* and shows the *Cliff Dweller* on that day. Picture No. 4 was known to him as "Anvil Bluff," located about twenty miles below the railroad, just above Tom Wimmer's ranch. Picture No. 5 is a picture of the *Cliff Dweller*, as it was finished from the hull, and before it was launched. Picture No. 6 is of the *Cliff Dweller* as it emerged from the main box canyon at Wolverton's ranch. This was after the name had been changed to the *City of Moab*. (R. 5278–5279.) It was coming upstream. Picture No. 7 is the same boat after he had refueled it at Wolverton's ranch. He loaned them about thirty gallons of gasoline. They used gasoline on that trip. Picture No. 8 is Wolverton's *Wilmont* at Wolverton's ranch, going downstream. Picture No. 9 is the *Wilmont* again, going downstream. Picture No. 10 is the mouth of three canyons about ten miles below Wolverton's ranch. (R. 5280.) Picture No. 11 is the lower side of Bowknot bend on the Green River. Picture No. 12 is the *Cliff Dweller* on Fort Bottom. Picture No. 13 is what was called Crescent Buttes just back of Townsite Bottom. Picture No. 14 is a picture of R. L. Rogers and himself camping on Townsite Bottom. Picture No. 15 is Turks Point below Townsite Bottom. Picture No. 16

is the upper part of Double Bowknot bend. Picture No. 17 is a scene on the Colorado River, called the Amphitheater, about fifty miles below Moab. Picture No. 18 is in the same locality on the Colorado River. (R. 5281.) Picture 19 is not far from Moab on the Colorado River; something like five or six miles.

All of these pictures are contained in Defendant's Exhibit No. 31. (R. 5282.)

Cross-examination (R., Vol. 30, pp. 5282–5283):

He made just the one trip to Moab, and that was in the *Wilmont* as a side-wheeler. (R. 5282.)

He didn't keep any diary and they were prospecting and looking for power sites, and he doesn't recollect how many days it took; but it wasn't a trip straight through. Ross Wheeler, Will Cassidy, R. L. Rogers, Mr. Wolverton, and himself were on the trip, and he took the pictures that were offered in evidence himself. (R. 5283.)

KNOX PATTERSON

For Defendant

(Record, vol. 30, pp. 5284–5287)

He resides at Moab, Utah, and by occupation is an Attorney-at-Law. He has been at Moab since 1909. (R. 5284.)

As he recalls, he has taken three trips on the barge of the Moab Garage Company. He went from the landing at Moab down to Shafer No. 1

Well, and he has taken two or three trips on the smaller boats of the Moab Garage Company. He doesn't know what it was commonly called, but he believes they referred to it as the *Speed Boat;* but he doesn't know whether it had a name or not.

On the trips that he has taken on the barge, he doesn't recall any obstacles or difficulties that were encountered; wasn't hung up on a sand bar at any time on these trips. (R. 5284–5285.)

On the trips that he took on the smaller boats, he recalls no difficulties or obstructions to navigation and wasn't hung up at a sand bar at any time.

The first time he was down on the large boat was shortly after No. 1 Well blew in, was perhaps two or three weeks afterwards, and the other trips were in the next succeeding months.

Prior to those trips he has spoken of, he had taken trips on the Colorado River in a motor boat back in 1910, 1911, or 1912; he doesn't recall the year. It was in a boat built by Merkins, and it was called the Merkins Boat. It had a name but he has forgotten what it was. It looked more like a box than it did a boat, was fifteen or eighteen feet long and six or eight feet wide, and he believes there were twelver or fifteen of them on the boat. (R. 5286.) He doesn't know what horsepower engine propelled the boat. The trips were just picnic and fishing trips, and they would go down the river probably six or seven miles and back up to Moab, and didn't encounter any difficulty with respect to sand bars or other obstacles or obstructions in the river, and he

doesn't recall any delay in the trips by reason of depths or condition of the river. His judgment of the season of the year would be that they were along in the month of August. (R. 5287.)

HYRUM H. TURNER

For Defendant

(Record, vol. 30, pp. 5288–5304)

He resides at Moab, Utah, and has been there between twenty and thirty years. He is seventy-nine years old and was born at Linton, Maine; and in his younger days had experience with boats both up and down the Penobscot River. (R. 5288–5289.)

When he came into the Moab country, he had a few head of cattle on Indian creek. He sold out there and went back to Moab.

During the years he was there, he did some trapping, and as a general thing, he used a boat pointed at both ends. He always poled his boats, and didn't use oars; just the paddle. He would use that to cross the river to get where he could get shallow water and eddies. (R. 5289.)

He has been down the river as far as the upper rapids, to what is called the Butler Trail, about four miles below the mouth of the Green River, and he has walked down by the rapids. He has been down that far several times. He couldn't count the number of times he has been in there with a boat, but it would be four, five, or six times down that far.

The power used was his hands, and with a pole and a paddle he would pole back up the river.

On these expeditions he got furs and would bring them back to Moab in his boat. The only time he towed any would be when he would get tired of poling and it wasn't because he couldn't pole, but it was a little rest to get out where there were bars or sand and to tow along a little way.

He had no trouble going up around the Slide at all, only he couldn't get bottom with his pole; it was fifty or one hundred feet, where he couldn't reach bottom. He used about a sixteen-foot pole, fourteen to sixteen feet. As far as sounding is concerned he has tried enough so he knows he couldn't strike bottom with his pole to get enough pressure to shove the boat upstream. (R. 5290–5291.)

On these trips he would take five, six, or seven hundred pounds.

He has taken several shorter trips; he couldn't tell the dates.

He knows of ten or fifteen trips that he has taken down from Moab and clear on to the junction, and has made a good many short trips.

The kind of furs he would get would be mink, fox, and coyotes, and he has trapped beaver for the state.

He has trapped down the river to the junction and up the Green River for some distance; fifty miles or probably more. He has been up as far as what was called Upheavel Bottom, and above Mr. Anderson's. This was with a boat similiar to the type he has mentioned, and he would pole on those trips with anchor ice running in the river.

In poling a boat he would follow the eddies and he might get up a little too far to get out and strike a sand bar, but if he would follow the main channel, there would be no trouble. He never had anything to bother when his boat was in the channel of the river; he might strike and swing right off and go on. (R. 5291–5293.)

There was always plenty of channel. He hunted as still water as he could get, in poling a boat up the river.

He recalls taking a trip from the mouth of the Dolores River down to Moab. He was trapping for the government. The first trip was about a year ago, and he brought the furs down in his boat to Moab. He always trapped for the money that was in it.

He has been on a trapping expedition from Westwater down to Moab. (R. 5293–5294.) He had furs loaded in his boats, and he brought his traps and camp outfit and on that trip he had two of his grandchildren with him; one was sixteen and the other was about twenty-one or twenty-two years old.

He rafted timbers to put the abutment of a bridge in from about eight miles up the river above the Moab bridge, and the abutment and stringers were brought down on the river.

He also worked on the barge of the Moab Garage Company for a time. (R. 5295.) He worked for them for about six weeks. Of course, he got on some sand bars, which he expects on any river, and

had a little trouble as they couldn't go through smooth all the time. Sometimes they would be on half an hour and sometimes longer, but were never detained so much but what they would make the round trip in two days.

They made trips where they loaded up with twenty tons and unloaded in one day. The round trip was forty miles.

When they got on sand bars, it was on account of not having an experienced man running the boat. He was a good practical man in every other way, but he never had experience on the water. Virgil Baldwin was in charge of the boat at that time.

He has never personally handled any power boats himself. He has run the big boat a little, but Virgil Baldwin was with him. He didn't understand machinery. (R. 5296–5297.)

No work or money has been spent, as far as he knows, in improving the navigability of the Colorado River. There was an ice gorge they had to shoot, but he didn't see that. (R. 5297–5298.)

He does not know of any characteristic or condition of the Colorado River or of the Green River, so far as he has navigated them, which would interfere with the navigation of those portions of the river in a boat of two feet draft, handled by one who knew the river. (R. 5298.) If they would stay on the shallows, it is all right; if they get off the shallows, sometimes of course there is a little trouble; he had sounded with an oar on each side, so as to know when they were going to strike a sandbar—guide the boat. (R. 5299.)

Cross-examination (R., Vol. 30, pp. 5300–5302):

When he was in Maine, pretty near as soon as he could paddle he would get in a canoe, and he has used a canoe on the Colorado River that the Mohawk Indians made. It is pointed at both ends, and he can turn it over his head and carry it. It weighs ninety-six pounds. (R. 5300.)

He has been over the river a whole lot, and people down there prefer the flat bottom boats because they haven't had the experience to use any other.

The canoe is lighter draft that a flat bottom boat and it cuts the water sharp.

He has been up from the junction in a canoe as is shown in the picture he has with him, and didn't have any difficulty coming up against the current. He would pole it the same as he would any other boat. He has not come up when the water was right at the highest, but when it was way up high.

He has never been on the Green in a canoe, but he has been up the Green twice. He believes the current in the Green is a little quicker and the Green is narrower than the Colorado, and at those places he would get more current, but when poling a boat he figures on keeping in the eddies whenever he can. (R. 5301–5302.)

Further cross-examination (R., Vol. 30, pp. 5303–5304):

When he came down from the Dolores River, he had the canoe—the first time he had a small boat. This was a pointed boat made at Dewey at the

mouth of the Dolores River, and he trapped mostly on the main Colorado River. He would come down and set his traps and stop and work on down.

When he came down from Westwater he had the canoe; he took it up to Westwater with a truck. He didn't take it up the river as it took them so much longer to go up and it was harder work and they could go up in a day with the canoe in a truck.

The logs that he spoke of he got at the river bend, above Nigger Bill's. They were mostly round logs to put in a wooden abutment, and he picked them up as they were mostly driftwood. (R. 5303–5304.)

GEORGE H. CHAFFIN

For Defendant

(Record, vol. 30, pp. 5305–5326)

He is fifty years old and of Provo, Utah. He first became acquainted with the Colorado River about 1895 at the mouth of Hanson Creek. (R. 5305.)

In that year he made a trip for the purpose of delivering freight and to work on the California bar. As he recalls the trip was made in March, and he stayed there about thirty days. At that time the main supplies were taken from the mouth of Hanson Creek to the California bar on the river with boats.

He was also on the river again in 1896 and 1897. (R. 5306.) On that trip he worked on the Moquie Bar, reaching the river at the mouth of Hanson Creek. Men and supplies were taken down the river about a half mile from the mouth of Hanson

Creek, and then boated to camp, a distance of about a mile. During that time he made trips to Moquie Bar and to Tickaboo Bar, rowing, poling, and towing up stream; also doing some sailing. (R. 5307.) A sail was made by putting a staff up on the end of the boat and using a piece of canvas. He did not sail up the rapids at Tickaboo that year but has sailed up them on a later occasion by aiding the boat some with a pole. He has also sailed up the rapids without aiding the boat.

He has taken boatloads of some twelve to fifteen hundred pounds to Moquie Bar and to Tickaboo Bar on the river and rafted mostly timber from ten to twelve feet wide and twenty to twenty-four feet long. (R. 5308.)

In 1897 and 1898 he worked on Tickaboo Bar and received supplies at the mouth of Hanson Creek. During that year he had more experience than during the year 1896–1897. He did more work. In 1898 he went down the Colorado River from Moquie Bar to Independence or Shock Bar, somewhere around fifteen miles below Halls Crossing. On this trip he had a raft twenty to twenty-four feet long and ten or twelve feet wide, and a boat; there being eight persons in the party. On the raft they carried grain, supplies, mining machinery, and rails. (R. 5309.) On that trip the boat, which was twenty feet long, carried probably twenty-five hundred pounds of material and the raft carried in the neighborhood of one thousand or fifteen hundred pounds of lumber and three

or four hundred feet of twelve-foot rails. His brother, Lew Chaffin, accompanied him on the trip, but Mr. A. L. Chaffin, former witness in the case, did not. They encountered no obstructions or obstacles on the trip and were hung up on no sand bars or rocks or rapids. (R. 5310.) They stayed at Independence or Shock Bar from sixty to ninety days and while there boated up and down Shock Rapids by rowing, sailing, or towing. He never sailed up Shock Rapids without the aid of a pole or towing. This occurred from about the first to the middle of April, during the high-water period. (R. 5311.) He does not know anything about the sale of the Independence Bar. He was there when an injunction was served, but does not know anything about the transaction. At that time he quit and returned to the river the next year, 1899, to the Moquie Bar. (R. 5312.)

During that year he did some sailing on the river, going upstream to Good Hope Bar, to which point he sailed and poled all the way, but did not get out of the boat. He did not tow the boat through the Hanson Creek Rapids or to the rapids at Tickaboo. He has sailed up the Bull Frog Rapids without the aid of a pole or rowing or towing, and has also sailed up the Smith Rapids without any aid. His brother Arthur was with him during that year [1899]. (R. 5312–5313.)

He was again on the river in 1900 and 1901, working on the Moquie Bar and on the Stanton dredge and during that time he saw other boats on the

river than the ones he used. In 1908 he saw the Galloway party going down the river. During each of the years testified to [from 1896 to 1901] he saw other boats on the river going up and down each year carrying men and supplies. (R. 5314.)

In 1900 he believes he saw the Strauss party first going down the river past the Moquie Bar. There were three boats in the party and they contained some load. He later went down the river to where the Strauss party was located, about a mile below Hall's Crossing.

He did some rafting of lumber from Moquie Canyon to the Stanton dredge, and from the vicinity of Tickaboo Canyon to the Stanton dredge. He had no trouble with the rafts. (R. 5315.) The rafting was done during the months of May and June in the high-water period.

He was not on the river all of the time during the years 1900 and 1901, but left in 1900 some time in July and returned in December, when he made a trip with Mr. Bennett and a party from Denver; he then came back again in 1901, some time in April. In 1900 he helped construct a raft and boat for Mr. Bennett and took some machinery and supplies down to the Olympia Bar. He afterwards rafted some lumber from the Tickaboo down to Olympia. This rafting was done about May or in the springtime, during high water.

He does not recall any other rafting during his experience on the river. (R. 5315–5317.)

From his knowledge of the river, it would not have been any more difficult to raft this timber down at the lowest stage he ever saw the river than it was when he rafted, but you would have to build the raft lighter, bigger; that would be all the difference there would be. (R. 5317.)

He was on the river in 1902, but he did not do any work. (R. 5317.)

During the time he was working there he made frequent trips up and down the river for distances of from ten to twenty miles either way from camp, some trips being as far up as Dandy Crossing, thirty-five miles from the Moquie bar, or thirty miles from the Olympia.

Part of the time he was working for himself and part of the time he was employed by Stanton for the Hoskinnini Mining Company, the Moquie Mining Company, and for L. M. Chaffin and associates.

In 1899 and 1900 he was a partner of L. M. Chaffin at the Moquie Bar. (R. 5317–5319.)

The lowest point on the river that he has traveled to below Dandy Crossing, was about four or five miles below the reef, across the Colorado River. The reef that makes a circle, starts in up towards Blake, comes around and down below the Shock Bar; he can't tell the exact distance—something like seven or eight miles. That is below Lake Canyon. Down the river about twelve miles, fifteen miles. The reef is not as far down as the San Juan River. He has never been down to the mouth of the San Juan.

It is the same thing called the San Rafael swell. It is the same thing; it is the same reef; it used to be called the swell. (R. 5319–5320.) He has never observed the ledge of rock extending down to and into the river at or near Lake Canyon. (R. 5320–5321.) The channel is narrow there. That is, the deep water is narrow; the creek spreads out, or the river, pretty well, the river channel is narrow. He remembers such a place. (R. 5321.)

He would say that the channel there was in the neighborhood of forty feet wide. He has never been on the Colorado River below Hite in the month of August, but has been on the river the other eleven months of the year. (R. 5321.)

He has operated boats on the river having a draft of as much as two feet, loaded part of the way.

In poling he has had an opportunity to observe the depth of the water, and during his years of experience he knows of no difficulty or obstacles that would make the types of boats he has been accustomed to difficult in the navigation of the stream up or down over that portion of the river on which he is familiar. (R. 5321–5323.)

Cross examination (R. Vol. 30, pp. 5324–5326):

The boats used by him were the general type of flat bottomed boats, he never having used keel boats.

He can not tell what types of boats were used by other parties whom he saw on the river, and could not say as to whether or not he was close to where they were. They were used by miners. (R. 5324–5325).

He was connected with Mr. Bennett's enterprises on the river, having worked for him there. (R. 5325.)

He never brought any of the rafts upstream. When he went down to Independence bar he went out by way of Hall's Creek. When he reached his destination the material of which the raft was built was used. Most of his supplies were purchased at Richfield and Loa, Utah, none coming from Greenriver, Utah. (R. 5326.)

EDWIN T. WOLVERTON

For Defendant

(Record, vol. 30, pp. 5327–5376)
(Record, vol. 31, pp. 5387–5425)

He is sixty-seven years of age, a mining and civil engineer by profession. He has followed his profession about forty years. (R. 5327.)

He has lived in or near Greenriver, Utah, having come there first in 1900. Prior to his arrival there he had had some boating experience when he was a boy on the Penobscot river in Maine. Following his arrival at Greenriver, he had a ranch down the Green River about twenty-five miles from the town.

He went into the country for his health and became interested in manganese deposits there, he having discovered some deposits on the east side of the Green River about twenty miles below Greenriver, Utah. (R. 5328.) The manganese claim in which he was interested, he patented and disposed of to the Colorado Fuel & Iron Company. There are other manganese deposits in the vicinity, but none in place. (R. 5329.)

He found some fair sized deposits to the east of his patented land, and some on the west side of the river; later he found some down the Green River about sixty miles below the town. None of these deposits had ever been developed at all and he can therefore not state the extend of the deposits.

The Colorado Fuel & Iron Company worked the manganese deposits that were acquired from him. He does not know the exact tonnage shipped from the property although it amounted to several thousand tons. The deposits on that land are not yet exhausted. (R. 5330.)

During the year of his arrival on the Green River he made a trip in a rowboat to the junction of the Green and Colorado Rivers. This boat drew about nine inches of water. The boat was operated with oars and he was gone ten or twelve days on the trip. In going upstream he rowed and towed the boat, the trip being a prospecting trip made in the month of February during the low stage of water; the minimum depth of the channel that they found being two feet. (R. 5331.) It would be pretty hard to state the ordinary depth of the channel because it varies so much, but it was pretty deep in places.

During that time, 1900, he also made at least one trip from his ranch up to Greenriver, Utah, rowing the boat except at the riffles, over which he towed. During the next year he built a boat and arranged it so it could be fit with a sail, the boat being about eighteen feet long and possibly three feet wide. (R. 5332.)

This boat was frequently loaded so that it drew two feet of water and was used on short trips. He was able to sail this boat successfully upstream but did not sail down with it.

In 1903 he built a motor boat named the *Wilmont*. It was twenty-seven feet long, five and a half foot beam and empty drew approximately ten inches of water. (R. 5333.) Under full load it would draw about three feet.

The boat was first equipped with a four horsepower motor and propelled with a stern wheel. He made one trip to Greenriver with the boat but had trouble because the power was not sufficient and it was necessary to help the boat over the riffles. He made two round trips to the junction of the rivers, and one trip to Moab and back with the same engine. (R. 5334.) On those trips he experienced very little trouble on the river, although the engine did not have sufficient power.

On one trip he went to the head of the cataracts. Coming back up they made very slow progress, making the six miles from the first cataract to the junction in two hours and fifty-eight minutes. They did not assist the engine in taking the boat over that portion of the stream. (R. 5335.)

On the trip that he went up to Moab, he went through the Slide with that engine about the same as we did on any other part of the river; it is rather swift where the Slide was located, a large eddy below it, a bend in the river immediately above; we would

follow up the eddy below the Slide, then set our boat over in behind the bend; the result was, the only swift water was had in passing across the channel.

He went up in still water, and then let the boat cross to the other side into the eddy on the other side and went up that. (R. 5336.)

Both of the trips made to the junction and to the head of the cataracts were made in the fall of the year, during the low stage of water. (R. 5336.)

The trip to Moab was made in spring of the year. As he recalls, during March before high water had commenced, they had to get in through the Slide, the progress being slow. Both of the trips made down to the junction and back were made for compensation. There were five persons in the party on each of these trips. (R. 5337.)

In 1903 or 1904, the year following the construction of the *Wilmont*, he installed a seven and a half horsepower engine in the boat, and changed from a stern wheel to a side wheel.

After the boat was changed they made two trips to Moab, one a personal business trip and one for compensation, taking tourists. He also made several trips to Greenriver, Utah, and back. On the trips to Greenriver he had no trouble whatever negotiating the riffles with his seven-horsepower engine, and he had no difficulty with the current in making progress on the trips to Moab. (R. 5337–5338.)

The reason for changing from the stern wheel to the side wheel was because with the stern wheel in

going up over the top of the riffles as the boat dropped over onto the leveler part of the stream it had a tendency to pull the stern wheel out, and it would spin, the boat would drop back a little. The water was comparatively level at the top of the riffles; when the boat came up sort of an incline, slight, of course, but it was an incline, and got down on to the level water, it pulled the stern wheel out. That would be going upstream. (R. 5339.)

The change reduced the draft slightly, because the weight of the stern wheel was on one end. (R. 5339.) The draft of the boat under ordinary load with the side wheel would be three inches less than with the stern wheel. (R. 5339.)

When you use side wheels in swift water there is not any danger of the boat being swerved around one way or the other by the water. You go ahead in a comparatively straight course as easily as you can with a stern wheel; they hold it with a rudder. Used rudder with stern wheel. The rudder had a pair; the pair set right forward of the stern wheel. The rudders extended lower than the paddle wheel—than the lowest paddle of the paddle wheel, possibly two inches, but they did not extend lower than the paddles of the stern paddle wheel. (R. 5340.) They place the side wheel a little higher on the boat with reference to the bottom of the boat, we place the side wheel a little higher than we did the stern wheel. Under those circumstances the boat would draw about the same amount of water. (R. 5340–5341.)

After installing the seven and a half horsepower engine and the side wheel he carried considerable supplies from Greenriver, Utah, to his ranch, and from his ranch to the Utah-Nevada Copper Company, twenty-five miles below. (R. 5341–5342.)

The copper property is a blanket deposit in porphyry, lime, and sandstone. It is operated with surface workings, probably fifteen feet deep, the area being covered possibly three hundred acres and the ore averaging from one and a half to three per cent copper. (R. 5342–5343.) According to the reports of the Denver Assay Offices, Reduction Works, the ore is a splendid concentrating ore and with a proper mill it could be successfully and profitably concentrated. (R. 5343–5344.)

He knows of low grade vanadium and uranium deposits about five miles east of the Green River and a vein of uranium also, one and a half per cent, which covers several acres occuring in the property of the Utah-Nevada Copper Company. No attempt has ever been made to develop that property. (R. 5344.)

He later had another fourteen-horsepower, two-cylinder engine in the *Wilmont*, and constructed two scows, one thirty feet long with a twelve-foot beam, and one twenty feet long with an eight-foot beam. These scows and the *Wilmont* were used for hauling copper ore from the Utah-Nevada Copper Company, and the *Wilmont* hauled several tons from the property to Greenriver, Utah. He does not remember

taking any of the scow loads to town. He became manager of the Copper Company and the company acquired an interest in the *Wilmont*. (R. 5344–5345.) The scows were built and owned by the company. Following the installation of the fourteen-horsepower engine in the *Wilmont*, he made several round trips to Moab for compensation. The Copper Company later built a boat named the *Colorado*. This boat he thinks was built in 1905 or 1906, and was powered with the seven and a half horsepower engine taken off the *Wilmont*. He remembers making a number of trips with the *Colorado*, down to the head of Stillwater Canyon, but the boat was not a success from a navigation standpoint, it being too light and the vibration was too great when the engine was running. The Copper Company, he thinks, quit operations in 1908.

In 1905, 1906, and 1907 he made several trips with both the *Wilmont* and the *Colorado*, for compensation. He remembers making one trip with the *Colorado* with a party of hunters, forty miles below, and with the *Wilmont* he made a number of trips with tourists and hunters. (R. 5346–5347.) All of these trips were for compensation.

He does not recall taking any representatives of an oil association down on any trip during that period. They frequently took supplies down to Townsite Bottoms on the scow, and then went down to the head of the cataracts from there in the motor boat. When supplies ran out they would come back to the

scow again and replenish them, the scow being a base for supplies. In going back up the scow was pushed up the river. (R. 5348.)

A scow is pushed rather than towed because on a short turn it may drag the boat off its course, but if you push it you can keep it in the channel.

In the winter of 1907–1908, or 1908–1909, the hull of the *Wilmont* got caught in the ice and damaged, and the machinery was taken out. He then built the *Navajo*, which was twenty-two feet long with a five-foot beam, drew eighteen inches of water empty and anywhere below three feet loaded. (R. 5348–5349.) He very often had it loaded so that it drew close to three feet of water. The *Navajo* was powered with the seven and one-half horsepower engine taken out of the *Colorado* hull, and propelled with a screw propeller.

He left the river late in 1912. The *Navajo* was built in 1908 and used for carrying hunting parties and tourists down to the cataracts, and the junction of the Green and Colorado. He also carried the city engineer of Salt Lake City, and one or two other men from Greenriver to Moab. (R. 5349–5350.)

He is not sure that any other trips were taken as far as Moab but some were taken close to Moab. These trips were with hunting parties, and hunting wasn't good at Moab. He did not stop because of any difficulties in navigation and was compensated for all of his trips. Supplies were always taken along on these trips and he also took supplies to

A. I. Anderson, down to Townsite Bottoms, for compensation. He also frequently towed rowboats loaded with supplies for other persons. (R. 5351.)

The *Navajo* was kept in operation for profit in navigating the river or for commercial purposes. He lived all the year around at his ranch and supplies came down from Greenriver mostly by boats. (R. 5352.)

At times supplies were brought in on the west side down to the mouth of the San Rafael and we brought the boat up to the mouth of the San Rafael and got the supplies. There is a sort of road on the east side, used to come around that way by the Wimmer ranch, but a very poor road. (R. 5352-5353.)

He made many trips a year to Greenriver and back with his boats. After disposing of his four-horsepower engine he never had any trouble negotiating swift water, riffles, or rapids with the *Wilmont*. In operating the boats on the rivers he had no serious difficulty at any time. During the first few years they touched sand bars but were off and on again. The longest he was ever on a sand bar with the *Wilmont* was three minutes.

They had no difficulty with the *Navajo* excepting at times in running through what rivermen call sand rolls; where the waves jump, they are always carrying a lot of sand; the engine would pick that up and leave a certain amount in the water jacket; frequently they had to clean that out; that is all. (R. 5354.) Aside

from his engine trouble he had no other trouble of any kind or character with the *Navajo*.

A sand roll is something that is left after a side wash is in flood; it brings in a large amount of sand and mud, gets that out into the river; of course the river is wider than the wash was, and spreads out a little, then the current in the channel starts to cut it in scallops. It only occurs right after a flood at some gulch.

That condition is quite unusual, excepting in July and August when the heavy rains occur across the country out on the desert. (R. 5354–5355.)

He has never been capsized by any of the waves and has never known anyone else to be capsized. He runs these waves head-on.

Driftwood occurs only from a flood and is an obstacle to navigation with a side wheel. (R. 5355.) During periods of driftwood he would run all right, but frequently damaged the paddle some. Driftwood always occurs with high water in the spring. (R. 5356.) It was of such amount or gravity that he kept off the river because of it; the driftwood usually follows the main channel; if the water is high, that is when most of the driftwood runs; it is in the channel. You can dodge to one side. (R. 5356.)

He has never found any great change in the channel of the river except when a flood comes in from the side, when for a few hours the channel is hard to find. (R. 5356.) He has never found it, even on such occasions, where there was not a channel if you knew

where to find it. The length of time the condition caused by the floods down side washes lasts depends a good deal on the situation; for instance, between his ranch, the Wimmer ranch, and Greenriver, the fall of the river is 2.8 feet to the mile; the current, of course, is swift; a flood coming is soon dislodged, just a few hours. (R. 5357.)

At other points on the river sometimes it takes a day or two for the channel to get back into its old bed, the river doing its own housecleaning. (R. 5357.) Stillwater canyon is no different from the upper canyon, Labyrinth canyon; the water is not as quiet in Stillwater canyon as it is farther up. It takes a little longer for the channel in those canyons to cut itself out than it does up in the swift water, that is all. (R. 5357–5358.)

After the first trip through such a place, in Stillwater Canyon, where sand and other material has been washed in from the side canyons, there is no difficulty if a sharp lookout is kept. (R. 5358.)

He means by keeping a sharp lookout that the surface of the channel is always covered with—the current is greater, or course, in the channel, and it is always covered with a light agitation, that is, when the wind is not blowing. Another thing, the drift usually follows the main channel; when the wind is blowing, the high waves is only in the deep water; you simply follow the high waves. He makes a distinction between current and channel where the river is wide; very frequently there is a lighter current, that

is, slower current, outside of the main channel; they will form on one side of the river or the other, or perhaps in the middle, and sometimes they even close at the lower end. (R. 5358–5359.) He would call the streams running through, currents. The channel is usually well defined, but something may cause—for instance, a rock may roll down off a sidehill and cause a change of the main current, that might split the main channel and drive some of the water to one side or to the middle of the river. (R. 5358–5360.)

If there be a more or less swift current over to the right bank and at the same time the deepest part of the river might be over at the left bank, usually there is only one explanation; it is an obstruction of some sort that has gotten into the river; might be a water-logged tree, or it might be a rock thrown in from a wall. It is possible such a thing would happen, but he is not supposing such a condition could exist. The swiftest part of the river always is the channel. (R. 5360–5361.)

When you have the high spring water so that the water is high in the river and comes up the slopes more, it may happen that at certain points there may be a ledge of rock, for instance, that in low water the river, or at least in a swift part of the river, does not touch; but at high water it might go against such a projection, and during that temporary period of high water only cause the current to apparently cross the stream. If that condition—if that high water condition—is only temporary, it might not, during that pe-

riod, cause the old channel, the deep part of the river, to cease to be the deep part of the river. His observation has been that the channel of the river is well defined within certain limits; it can not get very far one way or the other. (R. 5362.) This condition is true of both rivers. His knowledge and experience of the rivers is valuable to one attempting to navigate them and navigation can not be done without knowledge and experience.

There is some remarkable building stone between the head of Cataract Canyon and the junction of the rivers, but no attempt, so far as he knows, has ever been made to market this stone. One is a very high brown stone in slabs and the other a limestone, also in layers or slabs. The limestone takes a beautiful polish and shows pink crinoids. (R. 5363–5364.)

These deposits are five to six miles long and extend from the river surface to a height of 1,300 feet, and it would not be practicable to work or coin this building stone, except from the bottom of the canyon. (R. 5364.) If the quarries were worked and the stone taken out, at the present time he does not know of any other method of getting the stone out of there excepting by the river. (R. 5366.)

Picture marked "Defendant's Exhibit No. 32" identified by him as a cliff dweller's house, taken in the lower end of Grassy Bottom on the Green River. (R. 5367.)

Exhibit No. 32A is a motor boat called the *Ida B*, piloted by Harry Blake.

Exhibit No. 32B is a picture of Cataract No. 1. The people in the picture are Mr. and Mrs. Wimmer and family, and Alton Tanner and his wife and their children. The baby in the picture between the man and woman belongs to the Tanners. They were taken down to the first cataract in Mr. Wimmer's boat; he, Wolverton, being hired as pilot.

Exhibit No. 32C is a picture of the *Wilmont* pushing a scow loaded with ore. (R. 5368.) When the scow was pushed up or down river he had no trouble with sand bars. There were several tons of copper ore on the scow. The copper ore on the scow was taken to his, Wolverton's, ranch. The shipments of copper ore that were made were taken out for experiment purposes and he did the testing himself on his ranch. (R. 5369.)

Exhibit No. 32D is a picture of the *Wilmont* behind the scow loaded with ore and the motor boat *Colorado*.

Exhibit No. 32E is the picture of a two-story cliff-dweller's house on the lower end of Valentine's Bottom.

Exhibit No. 32F is a photograph of rocks.

Exhibit No. 32G is a photograph of rocks at the mouth of Horseshoe Canyon. The graphs appear at a height of from a few feet to fifty or sixty feet. (R. 5370–5371.)

Exhibit No. 32H is a picture of some pottery taken from a cliff-dweller's house on Grassy Bottom. It was taken from the cliff-dweller's house shown in Exhibit No. 32.

Exhibit No. 32I is a picture of the junction of the Green and Colorado Rivers, looking upstream.

Exhibit No. 32J is a picture of motor boats taken opposite his ranch, looking across toward his house and showing the Oppenheimer's boat, the *Wilmont*, the scows, the *Cliff Dweller*, and the *City of Moab*, and the *Colorado*. The boat by the *Colorado* is a big heavy row boat used in transporting freight. (R. 5371.) The picture was taken in 1909 or 1910, and is all one picture, the two sections appearing on two pages. (R. 5372.)

He has made a study of the cliff dwellers along the Green and the Colorado Rivers; and in comparing the skulls of the cliff dwellers with those of other Indians, the skulls of the cliff dwellers are rounder, better balanced, and have 32 teeth, while the Indians only have 28. As far as he was able to determine, the cliff dwellers were agricultural people. He reached this conclusion on account of the implements they left in their store rooms and farms. (R. 5372–5373.)

Several of the bottoms have small reservoirs, and the walls of them are still there. In a number of instances the old ditch line is still very plain. His conclusion is that the cliff dwellers certainly used the river, for the reason that their storehouses are often placed in the canyon, where they would be inaccessible, except by boats on the river.

There are marks down the canyon walls, showing where there were ladders and footholds up and down from the river. (R. 5373–5374.) They had to get

to those foot marks along the river; for instance, their storehouses in Stillwater canyon, where the walls are simply like the wall of that room on both sides, then they will get a small opening in one wall or the other, and there is a storehouse built up in there; usually those storehouses are built fifty, one hundred, two hundred feet above the ground. (R. 5374–5375.)

He has seen different sections of the west which attract large numbers of tourists. He has visited the Mesa Verde [Park], in the southwest corner of Colorado. He has been to Bright Angel Trail, on the Colorado River, but can hardly class himself as an authority on the subject of scenery. (R. 5375–5376.)

Recalled (R., Vol. 31, pp. 5387–5425):

He ceased operations with his boats on which he carried freight and passengers for compensation, late in 1912. He quit because he couldn't make it pay, as he didn't receive money that he considered paid him for the investment in making boats and the effort. The parties might be a month apart. (R. 5387.)

He couldn't compete commercially with the short haul from Greenriver to Moab, and with the river in its present condition, he couldn't very well handle larger boats.

He didn't spend any money for advertising in any way to attract tourists. He had no capital for such a purpose.

He couldn't build larger scows that would take a hundred tons for the reason that the river in its natural condition wouldn't allow the handling of a hundred ton scow, as here and there there would be a rock in the riffles that would need to be removed, and he didn't have the capital and couldn't earn enough money to warrant the building of larger boats. (R. 5388.)

There are places where it would be necessary to remove rocks in order to permit large boats to pass and if the rocks were removed from the Green River, boats of over three feet draft could be operated.

He doesn't recall any rocks in the Colorado River except at the Slide, but this is not a serious obstruction, and in its present condition a large boat that would respond to the rudder could be put through. (R. 5389.)

If he were operating a large scow there safely and conveniently with a fifty-ton or somewhat smaller load the difficulty in navigating, as he has found it, would be due entirely to rocks here and there in the channel, and not at the riffles particularly, or other places in the river, or as far as the width of the water is concerned. He believes he would exclude from his above answer the riffles as not being a menace to navigation, because at the present time, in handling a load up the river you have to dodge the rocks there, but it might be possible to get through them by great care. (R. 5390)

The removal of rocks would be necessary on the Green River between Greenriver, Utah, and the

Wimmer Ranch or the mouth of the San Rafael, and if a program of improvement were undertaken, he believes that a wing dam should be built so the current could be directed, or the channel more confined, as he has seen occasions when from one of the side channels there was a temporary stoppage of water or practically so.

He came down the Green River once when he had quite a load on the *Navajo*. The Little Valley reservoir had gone out and where it came into the Green River it almost shut the river off and backed the water up for fully twelve miles. (R. 5390–5391.)

He doesn't know how long this lasted, as he passed through just after the flood reached the river and went down to the town site bottom and right back—he believes he came back about two days afterwards and there was no sign of débris in the river. It had all been cleaned out.

He has never known an instance in time of flood or cloudburst when there would be washes down the side canyons bringing in such amounts of mud, sand, or débris as to dam the river entirely across. However, it has filled up the bottoms to such an extent that the river would back up. (R. 5392.)

He knew of one time when the Colorado River was backed up from a flood down Indian Creek. He arrived there a few hours after the flood came, and the water was backed up five or six miles, but there was a good channel on the west side across from the mouth of Indian Creek and he went through with no trouble.

Aside from these two occasions, he does not recall other occasions when a thing of this kind has happened, and on the occasion last mentioned, it didn't interfere with his progress on the river.

Rocks fall in the spring of the year, and during the heavy rains in summer, and if the river were used as an improved highway, he doesn't know whether it could be entirely corrected or not, but the uses of dynamite in removing such rocks would at least reduce the hazard. (R. 5393–5394.)

He has never known of any one getting hurt by the falling rocks, nor has he ever known of any boat being damaged by them, or even hit.

He has seen seasons when there was ice in the river, and some seasons when there was little or no ice. The ice is an obstacle when that condition occurs.

After he left Greenriver, he started surveying with the late Colonel Charles P. Tasker.

At the present time he is spending his time in the Henry Mountains, developing a gold property owned by himself and associates. The property has a mill on it and he has done sufficient exploration work so that he knows something about the extent of the ore bodies. It is opened up with shafts, tunnels, and open cuts. The vein he is working on at the present time is a little over four feet wide and on the plates they save eleven dollars per ton. There is other gold mineralization in that section. (R. 5395.)

That section in the Henry Mountains has not been thoroughly explored or prospected. It is a wild, uninhabited, sparsely settled country. The mountains are remarkably steep and broken and are quite heavily timbered. His nearest neighbor is eight miles away. The timber extends twenty miles north and south and ten miles east and west, and straight across country, it is about eighteen miles to the Colorado River.

His property is located near Mt. Pennell on Straight Creek, where the headwaters of Trachyte Creek are formed. (R. 5396.)

There are very poor roads available from the Henry Mountain region to the Colorado River.

He can go down Trachyte Creek and cross over to North Wash and down North Wash, coming out above Hite. He hasn't been over the road from the Henry Mountain region down Hanson Creek for several years. There is a road available down Halls Creek, which can be traveled on by teams and wagons.

To get to Torrey, he has to go around by Hanksville and the same thing is true to get to Escalante. Practically all of the road communication for that region comes via Hanksville. (R. 5397–5398.)

Cross-examination (R., Vol. 31, pp. 5398–5416):

The first cost of the *Wilmont* was possibly four hundred dollars, and installing the seven and a half horsepower engine made an additional cost he believes, of two hundred seventy-five dollars. He

would estimate that the change from a stern to the side-wheel cost in the neighborhood of one hundred twenty-five dollars. The fourteen horsepower engine added about five hundred fifty dollars. He doesn't believe there were any more alterations or changes in the *Wilmont*.

Altogether, he made five or six trips to Moab. At least five of the trips were made for compensation, carrying passengers, sight-seers, or hunters, and one of them was made for experimental purposes or pleasure. (R. 5399.)

He is sort of a hunter himself and when he took out the hunting parties he acted as guide.

During this same period of time, he took several trips in the *Wilmont*, that went as far up the Colorado River as Lockhart or Indian Creek. These were up past the Slide and he would say there were twelve or fifteen of these trips that were for the purpose of taking tourists, sight-seers, or hunters. (R. 5400.)

He took about thirty trips on the *Wilmont* down to the junction at which times he did not go up the Grand River. Some of them were hunting trips and some he took sight-seers down. None of these trips were when he was prospecting on his own account. When he has done some prospecting around the junction, he was invariably paid for it by Eastern people that he took down. In addition to this, he has taken probably half a dozen trips in the *Wilmont* as far as Valentine Bottom. (R. 5401.) These trips extended over a period of five years, 1903 to 1908.

The *Wilmont* eventually got caught when the ice broke up in the winter of 1907–1908, and was jammed. The hull was weakened, and he took out the machinery and abandoned it.

The *Colorado* was a cheap boat, and including the engine, he would say it didn't cost more than three hundred fifty dollars. He doesn't remember how many times he took the *Colorado* to Moab; he doesn't even recall taking it to Moab. He took the *Colorado* as far as the junction at least once on a hunting and sight-seeing trip. (R. 5402.) He eventually took the engine of the *Colorado* and used the hull as a freight scow, and it eventually went down the river; the last time he saw it, it was tied up on the west bank, he believes at Townsite Bottom. He only operated it as a motor boat for one year and as a scow possibly two years. When he built the *Colorado*, he was experimenting with light-draft boats, as he had to carry pretty heavy loads of feed for the horses, and every inch he could save in draft allowed him to take just so much more freight. (R. 5403.) He had no real difficulty, but it was a constant strain dodging obstacles, sand bars, and rocks, and after R. C. Wheeler quit as pilot, he was not always successful in dodging rocks and sand bars. He doesn't remember having touched a rock but once, but the first year or two after Mr. Wheeler quit, he hit sand bars now and then, but didn't get stuck on them, and didn't have to get out and push off; would usually let the water wash them off. (R. 5404.)

He might have used poles or oars. He carried no poles but did carry oars always on the motor boats. The reason he carried oars was that the engines he used were rather crude, inferior, and would frequently stop, and he would row ashore and at times would use them to get off of sand bars.

He found the sand bars to be the most troublesome in July and the last of August and would have trouble only at the mouth of washes that brought floods in after heavy rains.

What he terms Spring Canyon, he found particularly troublesome. It is about fifty miles below Greenriver. (R. 5405.)

He never had any trouble at the [mouth of the] San Rafael, although there is a good deal of débris and sand carried down that stream.

In October and November he found the best water to operate boats. Conditions were most objectionable when the spring water was going down in the latter part of June and forepart of July. He didn't get the same conditions on the river from heavy rains as he did from spring floods, the débris thrown into the river from floods being strictly local. (R. 5406.) After a flood comes in from one of the side canyons it is gone in a few days, except as in the case of Spring Canyon where the river is some twelve or fifteen hundred feet wide, and frequently the water spreads sand nearly across the river.

He doesn't understand or know the meaning of the words "crossing bar."

On the bends he always finds the deepest water on the outside, excepting where a rock has fallen off a cliff and the river channel will be diverted somewhat. Beyond a curve the channel of the river does not pass on to the other side unless there is an obstruction. (R. 5407.)

Referring to sheet #33 of Compl. Exhibit 10, between miles 70 and 71, after passing mile 70, as he remembers it, the current would not pass over to the other side of the river, there being no general rule as to where the channel crosses over to the other side.

There are places in Labyrinth and Stillwater Canyons where the channel crosses over to the other side, and when it swings across the river, there is invariably a cause for it. (R. 5408.) Sometimes it is a rock that has fallen off the cliff, or heavy rocks thrown in by a wash will deflect the channel, but he wouldn't say there would be any deflection of channel on account of the curve in the river. In the crossings of the current from one side of the river to the other, there will invariably be sand deposited on the short side of the crossing, but bars will not form clear across the river, and it has not been his experience that they do. Rocks that will change the current are sometimes visible and at other times are not. (R. 5409.)

It would be possible in coming upstream, if there had been a rock dropped from the side of the canyon and submerged a sand bar might form which was not

there when he went downstream, but this has not happened in his experience.

The cost of the boat, *Navajo*, including the engine was five hundred dollars, and it remained in operation four years.

He remembers taking it twice to Moab, once with the City Engineer of Salt Lake and the other time with sight-seers. He believes he has been possibly twenty times in the *Navajo* to the junction. (R. 5410.)

He carried supplies down, during his scouting trips in the Cataract Canyon and a number of sight-seeing parties and hunters. On the scouting trips, he was usually not financially interested but sometimes he was.

He left the *Navajo* high on the river bank at his little ranch twenty-five miles below Greenriver, in 1908 when he left that part of the country. He was last there in 1916 and the *Navajo* was still there. He didn't take the engine out—it was just left as he stopped using it. (R. 5411.)

He helped organize the Utah-Nevada Copper Company, the principal stockholder being a man by the name of Kendrick. The company was in existence about three years and then he abandoned the mine and abandoned the charter of the company. (R. 5412.) The principal asset of this company was the copper mine about twenty miles below his ranch, and seven or eight miles west of the river, and on the opposite side of the river from his ranch. (R, 5413.)

In 1903, 1904, and 1905 he took out thirty or forty tons of ore, some of which was sent to Denver, usually for experimental purposes. He shipped several tons of ore to Denver, the rest being right where he left it, at Elgin, below Little Valley, below Greenriver and on the bank opposite his ranch. He doesn't remember the occasion for leaving it there, but it wasn't because he couldn't get his boat up that it was unloaded there. (R. 5414.) His main camp was at his ranch, where the ore was brought in and unloaded on the opposite side. After the company commenced to quarrel it was simply left there, wasn't moved, and is still on the west bank. The ore arrived at this point on the west bank mostly overland by wagon and there was sort of a road built from the mine to the river opposite the ranch. Some of the ore was taken either to Elgin or Greenriver by team. (R. 5415.) He didn't have any teams on his ranch except hired teams. There was a road passable with a wagon from Wimmer's Ranch to Greenriver during the time he was there.

He was subpœnaed as a government witness in October and while he wasn't exactly ill, he told the Marshal he didn't feel like coming in at that time. (R. 5416.)

(Claimant's Exhibit No. 633, offered in evidence, being a letter from Mr. Wolverton to Mr. Ryan, June 17, 1929, R., Vol. 31, p. 5416.)

Redirect examination (R., Vol. 31, pp. 5417–5421):

When he made the statement in the letter, "The rivers indicated are not navigable on a commercial basis, but under stress of necessity certain stretches may be negotiated with light-draft boats of certain types," he meant that under present conditions of the river, unimproved as it is, that he could not compete in carrying freight on the long haul between Greenriver and Moab with trucks or the Denver & Rio Grande Western Railroad, and neither could he carry passengers and compete with the railroad, trucks, and buses. He couldn't carry them at the same price. (R. 5417.)

He has seen many thousand tons of rock fall about ten or twelve miles below Greenriver, he believes in 1910. He has seen rock fall just below the junction, and at the junction, and he has seen other rock fall but not in the river. There are only two occasions that he knows of rock falling in the river. The rock that fell ten or twelve miles below Greenriver was on the east side, when the face of the cliff broke off and fell down. It wasn't a slide. The other point was just below the junction, and he doesn't believe that fell in the river. (R. 5418.).

He has never attempted to navigate Cataract Canyon, on a commercial or on any basis. He has been through Cataract Canyon on foot along the bank of the river to the mouth of the Dirty Devil. (R. 5418–5419.) At times he had to climb out on the cliff and come in at another point. One place he recalls, ten miles below the first Cataract where he went out, and another place twenty miles below the

first cataract where he had to make a detour. It is quite a narrow canyon at the end of Cataract Canyon, but he could always find a little talus along the river that was not disturbed. (R. 5420.)

He has been to the Colorado River near the Colorado line, and has seen the river in that stretch at points. He doesn't know just what is called Desolation Canyon on the Green River, but he has been up the Green River as far as the mouth of Price River and he has crossed the Green River up above Jensen at various points. He has seen it at the mouth of the Duchesne and at the mouth of Bear River and at other points. (R. 5421.)

Recross-examination (R., Vol. 31, pp. 5422):

The building stone that he saw down at the junction of the Green and the Colorado Rivers, in his estimation, would weigh 145 pounds per cubic foot, and there are 27 cubic feet in a cubic yard, or 3,915 pounds per cubic yard of building stone. (R. 5422.)

Further examination (R., Vol. 31, pp. 5423–5424):

He made his own ranch on the Green River, although the ground had been occupied. The Wheeler Ranch was just above this place and is now known as the Wimmer Ranch.

Mr. Ross Wheeler died about eight or nine years ago.

In navigating these boats on the river he did not carry poles for getting free from sand banks, although he would carry little willow sticks for sounding the depth of the water. (R. 5423.) The pole that is

shown on the bow of the boat on photograph No. 9 is a sounding pole, and was simply to ascertain the depth of the water when he was navigating the boat. (R. 5424.)

Redirect examination (R., Vol. 31, pp. 5424–5425):

When he saw the river back up for some distance he meant that a partial dam was formed and a fill, and he could notice the progress of the stream was slower above. (R. 5424–5425.)

GEORGE H. DERN

For Defendant

(Record, vol. 31, pp. 5379–5386)

He resides in Salt Lake City, Utah, and is the Governor of the State, serving his second term as such. (R. 5379.)

He took a trip by boat on the lower Colorado River below Cataract Canyon. He went in at the mouth of Crescent Wash, which he believes, was two miles below the lower end of Cataract Canyon, and went down the river to Lees Ferry, Arizona, a distance of about 172 miles, all the way by boat.

Mr. Dave Rust accompanied him on this trip and they didn't encounter any sand bars, nor was the journey delayed in any way as far as he knows by sand bars. He did not observe any other difficulties or impediments to navigation.

The trip was made in April, 1926. (R. 5379–5380.) He believes they left Salt Lake City April 10, and got back about April 22. He first went to Moab and from there on down. (R. 5381.)

Stipulated that he would describe the boats in which he traveled substantially as Dave Rust did. (R. 5381.)

Just before he went on this lower Colorado River trip, and on the same trip away from Salt Lake, he went from Moab to Shafer No. 1 Oil Well, returning to Moab by boat; going down he went on the Moab Garage Company's large power boat, the one on which they transport all of the freight and other supplies to the well. They had a party of thirty or forty people on that day besides a lot of freight. He came back on a smaller and faster boat that same afternoon. (R. 5381.)

Neither on the journey downstream on the large boat not on the return trip in the lighter boat was he delayed in any manner, nor was the boat obstructed as far as he observed by sand bars, and everything went smoothly.

Cross-examination (R., Vol. 31, pp. 5382-5383):

The Moab trip was probably made on the day after he left Salt Lake, and his recollection is that it would be April 11, 1926.

When he left Salt Lake, he intended to take the trip down Glen Canyon to Lees Ferry. He made the trip from Moab to Crescent Wash by driving back to Greenriver and from there by automobile to Hanksville, by automobile from Hanksville to Granite Springs, and from there by wagon down to the river. (R. 5382.) It took them about two and one half days to go from Moab to the mouth of Crescent Wash. He didn't go right down from Moab to Lees Ferry

by water, as he had made arrangements with Dave Rust to meet him at Hanksville, and he doesn't know why he didn't go by boat to the point where he was going to meet Dave Rust, as it was never considered at all. He had never planned to take that kind of a trip. (R. 5383.)

Redirect examination (R. Vol. 31, pp. 5384-5386):

He has lived in the State of Utah for thirty-five years; was a State Senator for a considerable period; believes he has kept in intimate touch since statehood with affairs of the State, and as far as he knows, no money has ever been appropriated by the State or the Federal Government or any other agency, in improving navigation, either on the Colorado or Green Rivers or the San Juan River. (R. 5384.)

He has visited a good many of the scenic sections of the west—Zion's National Park, Bryce Canyon National Park, Grand Canyon, Rocky Mountain National Park, and Yellowstone National Park; and a good many places in California. He believes the scenic value of the lower Colorado and the Colorado River below Moab as far as he saw it, is an outstanding piece of natural scenery, and if it was developed so that it would be easy and convenient to make the trip, it would be very popular. He discussed this point on his trip down the river, and decided that it was one of the finest pieces of scenery in the world. (R. 5385-5386.)

THOMAS VARLEY

For Defendant

(Record, vol. 31, pp. 5425-5433)

He resides at Salt Lake City and his business which he has followed since 1899 is that of a mining and metallurgical engineer.

At the present time, he is associated with the Big Indian Copper Company that is owned by the Loose and Smoot interests. It is a low-grade copper deposit in sandstone, the copper being disseminated throughout in the form of azurite and malachite, with occasional amounts of cuprite and a small amount of metallic copper. He doesn't know how long the deposit has been known but the evidences are that as long as twenty-five years ago there were shafts sunk at various places on the property, and several tunnels run. (R. 5425-5426.) About five years ago, they did some churn and core drilling to determine the extent of the deposit. That showed there were evidently two deposits or two different strata which contain the copper. The one on top is approximately 40 to 60 feet in depth and comes to the surface, and then a deposit of clay which varies in thickness from 4 to 20 feet and below that is another deposit of copper slightly less in value than the upper strata. The lower deposit shows on the drill cores anywhere from 20 to 40 feet in thickness.

The copper content of the ore as determined from samples he has gathered and from samples of about three thousand tons which have been milled lately,

will average about 3.28 per cent copper. (R. 5427.) The lower deposit runs, according to the drill cores, about 2.4 and 2.6 per cent.

The content of the Utah Copper Company operating at Bingham is around 1 per cent, or slightly less.

The known length and width of these deposits of the Big Indian are that in one direction they have measured three-quarters of a mile; in the other direction five-eighths of a mile, and their opinion is at that depth it is covered up by deposits of débris from the LaSal Mountains, and the opinion of other geologists is that it will extend to an indefinite length toward the LaSal Mountains, but it is exposed on the surface an area three-quarters by five-eighths miles now, and probably a mile from where the present workings are there are two shafts that have been sunk at lower depths which contain very high grade ore; what he means by high grade ore would be about six to eight per cent copper. (R. 5428.) In the concentrates that they make of 40 per cent copper, there would be about three ounces of silver, and the tonnage in sight by the known limits of the ore body is between three hundred and fifty and five hundred thousand. They have constructed a mill and at the present time employ 22 to 24 men. The mill is built largely, on an experimental basis, to determine the best method of treatment, and experiments now indicate that they are warranted in going ahead with the larger plant. (R. 5429.)

He has personal knowledge of the vanadium operations and there is a plant about ten miles below

the Big Indian property almost due south that has a milling plant that has been operated, how long, he doesn't know, but they have operated and produced vanadium in commercial quantities.

He wouldn't say that the section in which the Big Indian is located has been thoroughly investigated and prospected. He has had probably ten or fifteen men bring samples to him from near-by properties which they claim are quite extensive and from examination seem to indicate that they carry values proportionate to the Big Indian property. There have probably been four properties within a radius of fifteen or twenty miles that have produced small quantities of mineral. He believes that that represents the entire research work, as there has been very little done. (R. 5430.) He would say that recent developments in the way of flotation have made properties like the Big Indian and others that might be near by, commercial and the treatment and handling methods now make the properties valuable, where before they were considered not valuable. There has been no campaign of research and investigation that he knows of comparable to the Tintic, Park City, or Bingham mining district. It is a very sparsely settled country and there has been very little done.

Cross-examination (R. Vol. 31, p. 5431):

He believes the Big Indian is a mine, that there is no doubt about it, and not a prospect. (R. 5431.)

Further examination (R., Vol. 31, p. 5432):

He couldn't tell exactly in what township and section the Big Indian is located. It is 37 miles

Southeast of Moab and is not on Indian Creek. (R. 5432.)

(It is located in Township 30 South, Range 24 East, in what is known as Indian Wash, almost south of LaSal.) (R. 5432.)

Redirect examination (R., Vol. 31, pp. 5432-5433):

The tonnage of ore in the Big Indian mine that he estimated, represents ore developed on the surface and in drill holes and tunnels.

There are probably a little over a ton and a half—thirty-one or thirty-two hundred pounds—of ore to the cubic yard. He has to be conservative in his estimates and he takes it for granted that it may be thicker or it may be thinner in some places. (R. 5432-5433.)

HENRY C. TASKER

For Defendant

(Record, vol. 31, pp. 5434-5451)

He resides in Salt Lake, is 35 years old, and his business is that of operating an apartment house.

He lived at Greenriver, Utah, and first went there in 1911, left in 1928, and took a trip to Townsite bottoms with Mr. Wolverton on a boat. (R. 5434.) He believes this trip was made in 1912, and they had a motor boat about 18 or 20 feet long with a screw propeller. It was a reconnaissance trip to look the country over with the idea of putting stock in it. There was a permanent camp at Townsite Bottom and they went on down to Valentine Bottom about

3 miles below; that was as far down the river as they went at that time. The purpose of the trip was for looking over the land to see if it could be used in the cattle business as a permanent camp on the west side of the river. (R. 5435.)

His father paid Mr. Wolverton for his services, but he didn't come back with Mr. Wolverton. He was down there about two weeks, and he got about the country in his scouting with a saddle horse, and after he finished his inspection he came back to Greenriver on his horse. On the trip down with Mr. Wolverton, there were not any difficulties encountered in navigating, and they didn't get on any sand bars, but when they went up below Fort Bottom and tried to get to the bank there, they got stuck in going to the east bank of the river, the current being on the west side at that point. (R. 5436.) He couldn't get up to the bank at all places along the river, and if he wanted to get to the east side and the current was on the west side, he would sometimes have a little difficulty, because he would get out of the channel when landing. Aside from that, the boat was not stuck at all on any sand bars, as far as he knows. He doesn't remember whether it was necessary to get into the water to get the boat off but it would have been the easiest way to do it. (R. 5437.)

As he remembers it, this trip was made in the month of July or August. The result of his investigation, was that he took some stock in there and had them there for about 3 years. During the 3 years,

he made one other motor boat trip down there with Mr. Anderson, who carried supplies for him in the boat. Mr. Anderson took several loads of supplies down there for him, but he only went with him once. He paid Mr. Anderson for his services. He made one trip down there with a rowboat. (R. 5438.) The rowboat belonged to a man named Wheeler, and he got it 4 or 5 miles below Greenriver, at a place called Little Valley. He took supplies down in that boat. He brought the boat up and sent his man around with the horses, and as he remembers, he rowed and poled the boat up but he doesn't recall doing any towing. He tried to buy the boat from Mr. Wheeler, who didn't want to sell it, but who loaned it to him with the understanding that he bring it back. He would rather have purchased the boat than to have taken it back, because he could have ridden back, as his saddle horse was down there. (R. 5439.) He didn't voluntarily take a trip up the river with a rowboat that distance.

Outside of the work incident to rowing and poling a boat upstream, he encountered no serious difficulties that he remembers, and he didn't have any difficulties going downstream. As he recalls, he was not hung up on any sand bars going down, but was on sand bars going up, as he was always hunting the easy way, and the river meanders from bank to bank, and he would try to cut across, and sometimes he could and sometimes he couldn't.

On the trip in Mr. Anderson's boat he didn't get hung up on any sand bars or strike any, as it was

in the spring and the river was reasonably high. (R. 5440.) This Anderson was A. I. Anderson.

In 1921 he had some boating experience with the Chenoweth party of the U. S. Geological Survey. They started from Greenriver, Utah, and left ahead of the other boats. Mr. Page and Mr. La Rue were with him, and they had an 18-foot boat that was specially constructed to go through the cataracts, decked over, with one cockpit in it. The rest of it was covered and had hatches on. (R. 5441.)

The survey started at the junction of the rivers. Mr. Page was a geologist and anything he would see that looked unusual, he would stop and go and examine it. The party stopped quite a number of times.

He was along in the capacity of a rodman. After he arrived at the junction, three other boats came down. (R. 5442.)

(Stipulated the other members of the party are the same as testified to by other witness. (R. 5443.)).

The party left Greenriver about the first of September and went clear through to Lees Ferry, leaving there in December. In making the topographic map, there were two rodmen; at times one man was used on one side and one man on the other side of the river, and at other times they would crisscross back and forth. Each one of the rodmen had a boat, not all of the time, but most of the time, and the party had their boats and they would go from point to point in the boats, sometimes cross the river and sometimes work half a day on one side. He has

never crossed the river on foot, but has walked as far as he could wade and swam the rest of the way. On the trip down from Greenriver to the head of the cataracts, he didn't encounter any sand bars. In Cataract Canyon, there are no sand bars. The water is so swift, it cleans them out. (R. 5443–5444.)

From the foot of the cataracts down to the Utah-Arizona State line, the boats got stuck on sand bars frequently, and on the trip down from Greenriver to the junction when the parties would land, they would get on sand bars, as they couldn't avoid that. (R. 5444–5445.)

In going down the river from Greenriver, Utah, to the junction when he was traveling straight down with no intention of stopping, he didn't have any difficulty with sand bars and didn't strike any at all, but if he wanted to go into the bank on the west side of the river, and the current was on the east side, it was impossible to get in constantly without hitting a sand bar. By that, he means he couldn't land on a sand bar without hitting it. (R. 5445–5446.) He means that the river doesn't go right out and end with a sharp bank in deep water. In order to get to the bank he would have to wade maybe 20 feet and sometimes farther, but he doesn't recall on any occasion, on that trip from Greenriver to the head of the Cataract Canyon, when the boat hit a sand bar in the channel of the river, or on any other occasion when he was landing or crossing the river to reach some point and deliberately left the channel.

There were no sand bars that he saw in Cataract Canyon, but from the foot of Cataract Canyon down to the Utah-Arizona line, he was frequently stuck on sand bars. (R. 5447.)

The other boats in that party used by members of the survey were also stuck on sand bars frequently. If the chief would tell you to go and give him a shot from a certain point, and you started to go over there, possibly wouldn't be enough water, and you would get stuck on a sand bar, just get out and pull the boat as far as you could, and leave it there and give him the shot; then he would come down—he worked one side of the river—come down to you and he would send the other man, possibly, to the other side of the river; he might get stuck, or might not; all depends on how the channel was, the current. Numerous times you could go right to the place he would send you without a bit of difficulty; other times you would have to get out and wade. (R. 5448–5449.)

As far as his personal experience goes, his boat never hit a sand bar or got stuck on a sand bar while it was in the channel of the river, on the trip from the foot of the Cataract Canyon to the Utah-Arizona line.

If the wind was blowing and it was rough, it was hard to determine a channel, but he could usually find it without any difficulty, and, as he remembers, he never got stuck or hit a sand bar except when he deliberately left what he knew to be the channel of the river. He never saw any boat or any other member of the party stuck on a sand bar in the channel. (R.

5449.) On the stretch of the river that he is testifying to he navigated the boat himself. This was on the stretch from the foot of the Cataracts to the Utah-Arizona line. Mr. Chenoweth would tell him where to come and go and what position to take on the river. He ran part of the cataracts with his boat. (R. 5450.)

Cross-examination (R. vol. 31, pp. 5451):

When he had his outfit down the river, he also brought supplies down from Greenriver, overland, using pack mules and pack horses. (R. 5451.)

HORACE W. SHELEY

For Defendant

(Record, vol. 31, pp. 5451–5466)

He resides in the Uintah Basin and Salt Lake City, Utah.

He has been in the Uintah Basin for the past two years as Federal Court Water Commissioner, and long before he was in the Uintah Basin he was doing work in the Colorado River Basin, including the Green River watershed in the Colorado River Basin. (R. 5452.)

He can point in Compl. Exh. 505 to one section in the Moab Valley, above the principal irrigated area, where there is a possibility for irrigation of about five thousand acres by storage of the water and one thousand acres without storage. He means that the land, water, climate, and soil are available. The water wouldn't come from the Colorado River, it would come from Mill Creek, a tributary of the river. (R. 5453.)

At the present time he is working on a project to irrigate a one-thousand acre stretch expending his own personal funds. The soil is mostly a wind driven soil of a fine texture, very fertile when watered. The growing season is long in the valley and fruits and vegetables mature much more quickly than almost anywhere else within hundreds of miles. (R. 5454.)

In referring to the Government document, the Atlas of American Agriculture, issued July 15, 1918, which is used by students of climate, including the Government weather Bureau, lines of equal temperature are shown making a great dip to the north along the Colorado River and at Moab. For example, the temperature is far warmer than would be expected in this latitude. (R. 5455.)

Sheets two and three of the advance sheets of the Atlas of American Agriculture show average dates of last killing frost and show the last killing frost occurs much earlier in the spring in the Moab section and the sections down the river, and it extends up into Grand Valley section in Colorado, both east or west of the river. The same thing is true of the Greenriver section, but not so much, as there is more liability of frost at Greenriver. (R. 5456.) The Government map corroborates his statements.

In the Moab Valley they can and do raise the so-called yam variety of sweetpotatoes, peanuts, and chufa, and these things can not be matured to any high quality anywhere else in that vicinity.

In northern Utah, while they raise sweetpotatoes, they don't mature very fully. Speaking of his own operations, the sweetpotatoes he raised from plants secured from Georgia were full of sugar. In the Moab Valley he can convert the sweetpotatoes into full maturity which can not be done in other sections around. (R. 5457.)

On Compl. Exh. No. 505 the Grand River project is not designated. This was later known as the Grand Valley project, and it was estimated there are sixty thousand acres that could be irrigated in Utah. (R. 5458.)

Outside of these areas there is no other substantial acreage that he knows anything about that is not shown, but the region has been very little investigated.

In a general way, he is familiar with the country in Utah lying within the Colorado River Basin, meaning the Colorado and its tributaries, and it is very thinly settled. (R. 5459.)

He is familiar with the country around the town of Greenriver, Utah, and he has a report of the Greenriver project by William M. Green, engineer, December, 1921, an official document of the Department of the Interior, United States Reclamation Service. (R. 5461.) The report belongs to the State Engineer, and it shows an acreage available in the immediate vicinity of the town of Greenriver of fifteen thousand acres, and he knows of an area in the vicinity of Woodside where there is a future possibility of approximately six thousand acres. Outside of this,

he personally knows of no other acreage in that section.

He knows that there are very extensive deposits of oil shale in the Colorado River basin, and there are Government reports that indicate the estimated number of barrels of oil in that section of the shale region. (R. 5462.) He has one with him, Bulletin 691-B, Oil Shale of the Uintah Basin, Northeastern Utah, being a document of the United States Geological Survey, published April 30, 1918, and on top of page 28 of this bulletin is a statement of the barrels showing that there are forty-two billion, eight hundred million barrels of oil contained in the shales. He hasn't personally investigated whether or not the oil shales extend southwesterly from the region indicated in the report. (R. 5463.)

There are a considerable number of veins of gilsonite in the Uintah basin, and while there may be other deposits he doesn't know any place else in the world where gilsonite is found. This material was named for Mr. Sam Gilson, who was prospecting in there. (R. 5464.)

He knows of coal veins in Grand County north of the railroad point of Thompson, at the mine of Sego, some five miles north of Thompson.

He spends seven months during the irrigation season on his duties of water commissioner, and his winters are more or less free. He has been in that section during the irrigation season for over two years. (R. 5465.)

Cross-examination (R. vol. 31, pp. 5466):

All of the water in Mill Creek is subject to right of prior appropriation, except in flood season, and the five thousand acres mentioned could only be irrigated during the excess coming down in the flood season and during the summer rains. Without storage, after the snow-melting season is over, whatever water was obtained for the purpose of irrigation would depend on whether or not there was rain. (R. 5466.)

F. W. KELLER

For Defendant

(Record, vol. 31, pp. 5467–5475)

He resides at Monticello, Utah, by profession is an Attorney-at-Law, and at the present time, is District Attorney of the Seventh Judicial District, which includes San Juan, Grand, Carbon, and San Pete Counties. He has lived in that section for a little over ten years, but he had no familiarity with it until he moved there. (R. 5467.) Since moving there, he has traveled over the San Juan country in Utah, and the country around Moab and Greenriver quite a little bit. He is acquainted with Elk Ridge, the Blue and LaSal Mountain sections, and he has seen the forests on the Elk Ridge and the Blue Mountains; also the LaSal Mountains. He knows that these forests are of rather large extent, consisting in the main of western yellow pine on Elk Ridge and Blue Mountains and quite a good deal of yellow pine on the LaSal Mountains; also Engleman spruce and some fir on the Blue Mountains. (R. 5468.)

He has had access to the report of the Forestry Department kept at the Forestry Office at Moab, and the report shows one hundred seventy-one million five hundred sixty thousand board feet of lumber on the two forests, being the north and south division of the LaSal National Forest. Of this amount, sixty-six million two hundred fourteen thousand is western yellow pine situated on the Elk Ridge, fifty-two million two hundred seventy-seven thousand is Engleman spruce, and on the combined forests including the Elk Ridge, Blue and LaSal Mountains there are one hundred nine million four hundred seventy-six thousand feet of western yellow pine. (R. 5469.) He doesn't know the date of the report, but he understands that it is the only record that the forest service has on the extent of the forest, but he couldn't say when the survey was made. He went to the forest office at Moab and also saw the Government records since he came [to Salt Lake City] and he got the figures from the record. (R. 5470.)

In a general way, he has personal knowledge concerning mineralized areas in San Juan and Grand County and knows mica when he sees it. (R. 5471–5472.) About three years ago a mining friend of his brought some samples that he claimed were mica. He submitted them to the Bureau of Mines and had them analyzed and obtained a Government report concerning mica in the United States. Acting on what he learned in this report, he filed on the claims.

They were located on Montezuma Creek, San Juan County, about twelve or fifteen miles from the San Juan River. (R. 5472.) He doesn't know what quantities of ore are being shipped from any property in the vicinity of Bluff, but in the ten years that he has been there, there has always been some mining for uranium and vanadium. The company that carried on these operations was the United States Uranium and Vanadium Company.

At what is known as Little Indian, about fifty miles, he would say, from the San Juan River and about a like distance from the Colorado River, about three years ago, they employed about seventy-five men in their operations in mining and refining ore. They ceased operations as he recollects in 1926. (R. 5473.)

He knows of the dry farming in the San Juan country, and has dry farmed himself, and until recent years the principal crop has been wheat and oats and some corn, but the last two or three years they have been growing beans and potatoes on rather a large scale, and the ground seems particularly suitable for these crops. He has known of three hundred bushels of potatoes that have been raised to the acre, and he knows from his own experience that they can grow as many as two hundred bushels to the acre on the dry farms most anywhere in that region. (R. 5474–5475.)

(Complainant's Exhibit 638, pages 613 to 648, inclusive, of a document known as Professional Paper 11, entitled "The Ore Deposits of Utah," Washington,

Government Printing Office, 1920, admitted as rebuttal testimony, subject to right of objection. R. 5479–5480.)

LEROY R. CHANDLER

For Complainant

In rebuttal

(R., Vol. 31, pp. 5501–5514):

He is executive assistant or principal clerk of the LaSal National Forest, and has been in the LaSal forest himself. (R. 5501.)

He can give the classification and acreage of merchantable timber only, as they carry no record of timber that is not of merchantable size.

By merchantable he means of sufficient size to cut commercially. The forest as a whole, contains approximately one hundred seventy-one million board feet of merchantable timber in yellow pine, Engleman spruce, and Douglas fir, with a scattering of white pine and Alpine fir.

The distribution of the LaSal Mountains is fifteen thousand three hundred forty acres in the spruce and fir type, containing approximately fifty million board feet.

On the Blue Mountains there is an acreage of ten thousand four hundred eighty-five acres, containing a stand of fifty-four million board feet of spruce, fir, and pine.

The South Elk Mountain has a timber acreage of eleven thousand three hundred thirty-seven acres, containing a stand of yellow pine only of thirty-four million board feet.

The North Elk Mountains have eleven thousand six hundred twenty-eight acres of merchantable yellow pine, with a stand of thirty-two million board feet.

The balance of the land of the LaSal forest in timber classification is nineteen thousand five hundred two acres of a mixed type, which is a stand of various classes of trees, none of which occur in sufficient groups to be classified as merchantable; twenty-two thousand six hundred forty-seven acres of woodland type being Juniper and Pinion, with no commercial value except for posts; seventy-nine thousand seven hundred sixty-four acres of brush land, being oak brush; five hundred twenty-eight acres of purely grazing land with no timber on it; and seven thousand four hundred eighty-five acres of barren land. (R. 5502–5503.)

At the present time there are saw mills in operation on the LaSal forest. They are stationary mills, operating in the yellow-pine type, with a yearly cut of approximately two hundred thousand [board feet]. The lumber is sold to ranchers, homesteaders and merchants of Monticello and Blanding principally, and is transported by wagon and truck. He does not know of any use of the Colorado River at the present time for the purpose of bringing lumber rafts down. (R. 5504.)

He is familiar with the use of the LaSal National Forest for grazing purposes, and the land has been classified for that purpose. The land is classified by

more of a potential intensive reconnaissance of forage plants and from this the forage acres are derived.

On the LaSal forest, the range classification states that 5.38 land acres constitute one forage acre, and for the entire forest, five forage acres constitute summer range for one cow for a five and a half month season. (R. 5505.) Basing his calculations on the data just given, it shows that the Forestry Department figures approximately twenty-seven land acres or five forage acres to each animal for a five and a half month summer season. There is no winter range, as it is a high range not adaptable for winter grazing because of the heavy snowfall and early and late frost.

He has the annual precipitation taken from the towns of Blanding, Bluff, LaSal, Moab, and Monticello that are approximately to the forest, and it is a thirty-year average, and shows the following yearly precipitation: Blanding, 18.29 [inches]; Bluff, 6.80 [inches]; LaSal, 11.30 [inches]; Moab, 9.08 [inches]; Monticello, 18.39 [inches].

The reports show the land available for dry farming pertaining to the Elk Mountains and it is estimated that there are one hundred twenty-two acres of second-grade agricultural land on the entire mountain. (R. 5507–5508.)

Cross-examination (R. Vol. 31, pp. 5508–5513): Mr. Rocky, Soil Expert of the Bureau of Soils, made the land classification and he [Chandler] found

the one hundred twenty-two acres in the Land Classification Report, it being in scattered patches over the mountain, not all in one place. (R. 5508.)

The Elk Ridge is reserved for water shed and timber protection; in fact, the protection of natural resources.

In the timber cutting operations of the LaSal Mountains, agents of the Government supervise the cutting with the purpose in view of seeing that the trees that are designated for cutting are the only ones cut and the cutting is permitted to conserve timber and eliminate defective timber. The timber areas on the Elk Ridge, Blue and LaSal Mountains are being conserved for future generations to a certain extent, but there is some cutting in the smaller timber for poles, posts, and derrick sets, etc. (R. 5509.)

The smaller trees are of use for that purpose and any cutting that is done on them is in such a manner as to permit the full growth of the best types of trees for the future. When a permit is given to stockmen to graze on any of the reserved area, the permit limits the number of stock that is permitted to graze over a given area. The figure he gave of acres per head of stock, are fixed by the Department as the maximum that would be permitted to graze and is an average for the forest. (R. 5510.) The figure he gave was an average for the forest. The average number of forage acres per cow for the forest was an average figure. There are spots on the forest where two forage acres constitute feed for a cow, and there are spots on the forest where forty will not constitute feed for a cow. (R. 5511–5512.)

The rules that are followed are given to them by the District Office, and when a permit is given it specifies the number of head of stock that will be permitted on the area to which the permit applies. The purpose of that limitation is to prevent any possible damage to the land as grazing land; although the department does not fix the acreage over which the permit extends, they fix the acreage for the entire forest and the number of stock that can be permitted to graze on the forest without detriment to the forest protection. (R., 5512–5513.)

Redirect examination (R. Vol. 31, pp. 5513–5514):

The effect of overgrazing on the forest is erosion, as an overgrazed area means an area deprived of sufficient vegetative covering to protect the surface soil from rainfall and wind erosion, and overgrazing also prevents the land from reseeding itself. (R. 5513–5514.)

GEORGE E. WOOLLEY

For Defendant

(Record, vol. 31, pp. 5514–5517)

He resides in Salt Lake City, Utah. His official position is acting Register of the U. S. Land Office.

He wouldn't be able to say whether he has in his possession, the official records of the United States, with reference to withdrawals along the Green River, between the town of Greenriver, Utah, and the mouth of the Green River and on the Colorado River between Castle Creek and the head of Cataract Canyon,

as he checked it from Township and Range on the map and not from any known points as to canyons.

All of the land immediately adjoining the Green River from a point on the North boundary of Township 24 South, Range 17 East, Salt Lake Meridian, and to the junction of the Colorado River in Township 30 South, Range 18 East, same Meridian and the lands immediately adjoining the Colorado River from the North boundary of Township 25 South, Range 22 East, Salt Lake Meridian to the South boundary of Township 30 South, Range 18 East, Salt Lake Meridian, has continually been in a state of withdrawal by the Government since September 10, 1909, to the present time. (R. 5514–5515.) The order has never been modified so that the minimum width withdrawn has never been less than a quarter of a mile on each side of the river by legal subdivision, and the language, by legal subdivision, within less than a quarter of a mile on each side of the river by legal subdivision would be that any legal subdivision on either side of the river within a quarter of a mile from it, would be thus withdrawn in its entirety. (R. 5516–5517.)

DISCUSSION BY SPECIAL MASTER AND COUNSEL

(Record, vol. 32, pp. 5519–5536)

By the SPECIAL MASTER:

Regarding the testimony of Mr. Wolverton as to river improvements and the draft of boats that could be run on the Green River, if rocks could be removed, is ordered stricken from the record. (R. 5519–5520.)

As far as the army engineers' report is concerned, and the opinion of army officers, or any other persons, as to what might be done with the river in order to improve its navigation in 1896, he holds equally immaterial and irrelevant and would not consider that portion of the report. (R. 5521–5522.)

In the quantities of Government reports which have been introduced, he will use such portions as are pointed out to him on argument or otherwise, and will indicate such portions as he considers relevant or irrelevant, and the portions that he considers irrelevant and immaterial he will rule on in his report. (R. 5522–5523.)

When reports or printed documents are introduced, it is manifest that it is not everything in the reports that is relevant to the case, and if he makes use of any portion that either side consider were not relevant or material, counsel on either side will have an opportunity to take exception to his report. (R. 5523–5525.)

Mr. Farnsworth states that he claims nothing for any testimony of Mr. Wolverton with respect to the improvement of navigation of the rivers, or the effect of such improvement upon navigation. (R. 5525–5529.)

The Special Master. I am not going to construe Mr. Wolverton's testimony. I am going to strike it out. Wherever it has any reference to operation of boats in an improved condition of the river, I am going to strike it out of the river.

Mr. BLACKMAR. That leaves considerable testimony in there about the operation of fifty and one hundred ton boats. Do you claim on the fifty and one hundred ton boats it is possible to operate them under Mr. Wolverton's theory without improving the river?

Mr. FARNSWORTH. I make no claim that any answer of Mr. Wolverton's is proper evidence in this case or shall be in any manner considered by the court in this case as evidence that a fifty or one hundred ton boat could operate on that river without those improvements. (R. 5530.)

The SPECIAL MASTER. * * * if there is anything in Mr. Wolverton's testimony, whether in this portion transcribed or otherwise, that has any reference to the question of navigability in an improved condition of the river, I will strike it out when the final transcript is given me. (R. 5531.)

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No. 14, Original

In the Supreme Court of the United States

OCTOBER TERM, 1930

THE UNITED STATES OF AMERICA, PLAINTIFF

v.

THE STATE OF UTAH, DEFENDANT

PLAINTIFF'S EXHIBITS NOS. 71, 75, 80, 82, 85, 89, 94 567, 609, 631, AND 633. DESCRIPTIVE INDEX TO ALL EXHIBITS

APPENDIX TO ABSTRACT OF TESTIMONY

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In the Supreme Court of the United States

OCTOBER TERM, 1930

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APPENDIX TO ABSTRACT OF TESTIMONY

COMPLAINANT'S EXHIBIT NO. 71

NAVAJO RESERVATION

EXECUTIVE MANSION,

Washington, D. C., May 17, 1884.

It is hereby ordered that the following-described lands in the Territories of Arizona and Utah be, and the same are, withheld from sale and settlement and set apart as a reservation for Indian purposes, viz:

> Beginning on the one hundred and tenth degree of west longitude at 36° and 31′ north latitude (the same being the northeast corner of the Moqui Indian Reservation); thence due west to the one hundred and eleventh degree 30 minutes west longitude; thence due north to the middle of the channel of the Colorado River; thence up and along the middle of the channel of said river to its intersection with the San Juan River; thence up and along the middle channel of San Juan River to west boundary of Colorado (32° west longitude, Washington meridian); thence due south to

the thirty-seventh parallel north latitude; thence west along said parallel to the one hundred and tenth degree of west longitude; thence due south to place of beginning: *Provided*, That any tract or tracts within the region of country described as aforesaid which are settled upon or occupied, or to which valid rights have attached under existing laws of the United States prior to date of this order, are hereby excluded from this reservation.

CHESTER A. ARTHUR.

EXECUTIVE MANSION, *January 6, 1880.*

It is hereby ordered that the following-described country lying within the boundaries of the Territories of New Mexico and Arizona, viz,

commencing in the middle of the channel of the San Juan River where the east line of the Navajo Reservation in the Territory of New Mexico, as established by the treaty of June 1, 1868 (15 Stat. 667), crosses said river; thence up and along the middle channel of said river to a point 15 miles due east of the eastern boundary line of said reservation; thence due south to a point due east of the present southeast corner of said reservation; thence due south 6 miles; thence due west to the one hundred and tenth degree of west longitude; thence north along said degree to the southwest corner of said reservation in the Territory of Arizona, as defined by Executive order dated October 29, 1878, be, and the same is hereby, withdrawn from sale and settlement and set apart as an addition to the present Navajo Reservation in said Territories.

R. B. HAYES.

COMPLAINANT'S EXHIBIT 75

REPORT OF SPECIAL SURVEY AND EXAMINATION OF THE GREEN AND COLORADO RIVERS BETWEEN GREENRIVER AND MOAB, UTAH

By W. G. Hoyt, Hydraulic Engineer, U. S. Geological Survey

February, 1929

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Summary of Investigation

The object of the field investigation, the results of which are here set forth, was to collect information with respect to the physical characteristics of the Green and Colorado rivers between Greenriver and Moab, Utah. The Green River was examined from September 27 to October 17, 1928, and the Colorado River from October 18 to 23.

The examination covered 121 miles of Green River, from a point 4 miles above Green River, Utah, to the mouth, and 80 miles of the Colorado River, from the head of Cataract Canyon, 3 miles below the mouth of the Green, to Castle Creek, 15 miles above Moab—a total distance of about 200 miles. I was accompanied on the entire trip by S. H. Moyer, of the Interior Department, and H. E. Blake, jr., of Monticello, Utah. Virgil Baldwin and Merle Morse of Moab, Utah, were also with the party on the Colorado River from the head of Cataract Canyon to Moab. Mr. Moyer assisted me as rodman. Mr. Blake was boatman, cook, and for part of the time, rodman. Mr. Baldwin, assisted by Mr. Morse, operated the motor boat from Moab to the junction of the Green and Colorado rivers and return to Moab.

Surveys were made with a plane-table and a Gale explorer's alidade. The party was transported by boats, except between Moab and Castle Creek, where an automobile was used. Nearly 200 photographs were taken at places shown by appropriate symbols on the accompanying plate. These photographs were made with standard Eastman cameras; one a panoramic and the other post-card size. The reproductions in this report are made from the original films without enlargement and they portray in my opinion the conditions as they existed at the time of my investigations. Those that illustrate specific features are referred to by number in the text; the others give a general picture of the river conditions. The location at which the photographs were taken is shown by circles on the various plates and maps. The arrow indicating the direction in which the camera was pointed and the number refers to the photograph.

Boats were used in making the investigations as follows:

1. Evinrude row boat, 16 feet long, 4-foot beam, 1½ feet deep, with 3 feet square stern designed for use with an outboard motor. The keel ran the entire length of the boat and projected about 2 inches below the bottom. This boat was used—

(a) on the Green River from Greenriver, Utah, to a point 3 miles upstream, carrying Blake and me with the Johnson twin outboard motor;

(b) on the Green River from Greenriver, Utah, to mouth of the San Rafael River, carrying supplies for three men for one week and bed rolls, but no tents nor the motor; in the quiet stretches of water, Blake, Moyer, and I rode; through the riffles in general only Mr. Blake;

(c) on the Green River from the San Rafael River to the mouth of the Green, carrying about two-thirds of supplies for four men for three weeks, also Moyer and Blake;

(d) on the Colorado from its junction with the Green River to Moab, carrying Johnson twin outboard motor, Blake and me, field equipment, and one-third of supplies for four men for three weeks. Without the motor in the boat generally 15 inches of water was sufficient to prevent the bottom of the boat hitting bottom. With the outboard motor in place nearly two feet were required to prevent the bottom of the motor dragging on the bottom.

2. Canvas-covered canoe 15½ feet long, 4-foot beam, 1 foot deep, equipped with oars. I rode in this canoe and carried one-third of the supplies from the mouth of the San Rafael River to the mouth of the Green. The canoe was towed back of the motor boat from the mouth of the Green up the Colorado River to Moab with only enough load to make it tow well. The canoe could be used freely in between 6 inches to 8 inches of water.

3. Motor boat 24½ feet long, 6-foot beam, 5-foot beam at stern, 2½ feet deep, with Chandler 6-cylinder motor and a fixed propeller requiring about 2½-foot draft to run without propeller striking bottom. This boat was used from the mouth of the Green River to Moab, carrying Baldwin, Moyer, and Morse, and nearly all the supplies and gasoline and also towing the canoe.

Stream Flow

The magnitude of the stream flow has so definite a bearing on the channel conditions that it seems desirable to determine as nearly as possible the

relation between the flow in the Green and Colorado rivers at the time the investigation was made and the stream flow which has prevailed during September and October as shown by the gaging-station records.

The stream-flow characteristics of the stretches of the Green and Colorado rivers discussed in the report are best shown by records collected at the gaging stations on Green River at Greenriver, Utah, and Colorado River near Cisco, Utah. Records have been collected by the United States Geological Survey and are available for these stations as follows:

GREEN RIVER AT GREENRIVER, UTAH

1894. Station description B. 131, p. 48.
1895. G. H., B. 140, p. 202.
1896. Daily and monthly discharge, 95, 96, 18A pt. 4, p. 275; G. H., W. S. P. 11; p. 70.
1897. Monthly discharge, 19thA pt. 4, p. 398; G. H., W. S. P. 16, p. 136.
1898. Monthly discharge 20thA pt. 4, p. 387; G. H., W. S. P. 28, p. 134.
1899. Discharge measurement, G. H., W. S. P. 37, p. 293.
1900.
1901. Monthly discharge, W. S. P. 75, p. 104.
1902–1904. None.
1905. Monthly discharge (a), W. S. P. 175, p. 20.
1906. Monthly discharge (a), W. S. P. 211, p. 29.

(a). Revised in W. S. P. 269, p. 44.

1907. Monthly discharge (a), W. S. P. 249, p. 39.

1908. Monthly discharge (a), W. S. P. 249, p. 39.

1909. Monthly discharge 1905 to 1909, W. S. P. 269, p. 44.

1910. Daily and monthly discharge, W. S. P. 289, p. 28.

1911. Daily and monthly discharge, W. S. P. 309, p. 19.

1912. Daily and monthly discharge, W. S. P. 329, p. 20.

1913. Daily and monthly discharge, W. S. P. 359, p. 20.

1914. Daily and monthly discharge, W. S. P. 389, p. 18.

1915. Daily and monthly discharge, W. S. P. 409, p. 20.

1916. Daily and monthly discharge, W. S. P. 439, p. 19.

1917. Daily and monthly discharge, W. S. P. 459, p. 15.

1918. Daily and monthly discharge, W. S. P. 479, p. 13.

1919. Daily and monthly discharge, W. S. P. 509, p. 110.

1920. Daily and monthly discharge, W. S. P. 509, p. 110.

1921. Daily and monthly discharge, W. S. P. 529, p. 72.

1922. Daily and monthly discharge, W. S. P. 549, p. 64.

1923. Daily and monthly discharge, W. S. P. 569, p. 57.

(a). Revised in W. S. P. p. 44.

1924. Daily and monthly discharge, W. S. P. 589, p. 57.
1925 (b).
1926 (b).
1927 (b).
1928 (b).

COLORADO RIVER NEAR CISCO, UTAH

1914. Daily and monthly discharge, W. S. P. 389, p. 48.
1915. Daily and monthly discharge, W. S. P. 409, p. 68.
1916. Daily and monthly discharge, W. S. P. 439, p. 82.
1917. Daily and monthly discharge, W. S. P. 459, p. 74.
1918–1922. None.
1923. Daily and monthly discharge, W. S. P. 569, p. 13.
1924. Daily and monthly discharge, W. S. P. 589, p. 15.
1925 (a).
1926 (a).
1927 (a).
1928 (a).

Table 1 on page 6 shows the mean daily gage height and the mean daily discharge of Green River, at Green River [Greenriver], Utah, and table 2 on page 7 similar data for the Colorado River near Cisco. Both tables are for the period September 1 to October 31, 1928, and cover the time of my investigation. This information was furnished by A. B. Purton, District

(a). Revised in W. S. P. 269, p. 44.
(b). Not available in printed reports.

Engineer, U. S. Geological Survey at Salt Lake City, and is based on observations and measurements made under his direction and supervision.

TABLE 1.—*Daily gage height in feet, and discharge in second-feet, of Green River at Greenriver, Utah, for September and October, 1928*

Day	September		October		Remarks
	Gage height	Discharge	Gage height	Discharge	
1	6.04	2,640	6.27	1,930	Peak on September 27, 9 p. m. Gage height 9.8. Discharge 19,800.
2	5.94	2,440	6.08	1,680	
3	5.92	2,410	6.01	1,590	Peak on October 12, 3 p. m. Gage height 9.8. Discharge 15,400.
4	5.89	2,350	5.97	1,550	
5	5.87	2,320	5.96	1,540	Peak on October 15, 3 a. m. Gage height 7.8. Discharge 5,840.
6	5.85	2,280	5.97	1,550	
7	5.80	2,200	5.99	1,570	Peak on October 17, 10 a. m. Gage height 8.15. Discharge 7,170.
8	5.77	2,150	6.03	1,620	
9	5.74	2,100	6.06	1,650	Peak on October 31, 4 p. m. Gage height 8.35. Discharge 7,990.
10	5.71	2,060	6.05	1,640	
11	5.68	2,020	6.20	1,830	
12	5.64	1,960	9.20	12,000	
13	5.60	1,900	7.25	4,040	
14	5.56	1,840	7.08	3,570	
15	5.55	1,830	7.43	4,600	
16	5.54	1,820	7.60	5,150	
17	5.53	1,800	8.10	6,970	
18	5.53	1,800	7.75	5,660	
19	5.54	1,820	7.72	5,560	
20	5.53	1,800	7.59	5,120	
21	5.52	1,790	7.37	4,410	
22	5.49	1,750	7.38	4,440	
23	5.46	1,710	7.25	4,040	
24	5.45	1,700	7.13	3,700	
25	5.45	1,700	7.01	3,390	
26	5.44	1,690	6.91	3,140	
27	(1)	3,800	6.87	3,040	
28	6.9	3,620	6.83	2,950	
29	6.16	1,780	6.83	2,950	
30	6.16	1,780	6.80	2,880	
31			7.50	4,820	

[1] Discharge based on average of 24 hourly readings.

TABLE 2.—*Daily gage height in feet and discharge in second-feet of Colorado River, near Cisco, Utah, for September and October, 1928*

Day	September		October		Remarks
	Gage height	Discharge	Gage height	Discharge	
1	2.77	3,570	2.51	3,060	Peak on September 28, 4 a. m. Gage Height 3.9. Discharge 6,200.
2	2.57	3,180	2.49	3,030	
3	2.57	3,180	2.43	2,920	Peak on October 14, 8 a. m. Gage Height 6.9. Discharge 16,400.
4	2.53	3,100	2.40	2,860	
5	2.47	2,990	2.38	2,830	Peak on October 15, 4.30 a. m. Gage Height 6.8. Discharge 16,000.
6	2.41	2,880	2.37	2,810	
7	2.34	2,750	2.38	2,830	Peak on October 31, 5 p. m. Gage Height 4.6. Discharge 7,980.
8	2.23	2,560	2.37	2,810	
9	2.21	2,520	2.33	2,740	
10	2.11	2,360	2.29	2,660	
11	2.15	2,420	2.36	2,790	
12	2.22	2,540	2.63	3,290	
13	2.34	2,580	3.43	2,920	
14	2.26	2,610	6.1	13,200	
15	2.26	2,610	5.5	11,000	
16	2.24	2,580	3.8	5,780	
17	2.23	2,560	[1] (3.5)	4,920	
18	2.22	2,540	[1] (3.3)	4,520	
19	2.22	2,540	[1] (3.2)	4,300	
20	2.19	2,490	[1] (3.1)	4,090	
21	2.17	2,460	3.02	3,920	
22	2.39	2,840	2.95	3,770	
23	2.61	3,260	2.89	3,650	
24	2.62	3,270	2.91	3,690	
25	2.52	3,080	2.87	3,610	
26	2.44	2,930	2.81	3,490	
27	2.38	2,830	2.80	3,470	
28	3.17	4,410	2.78	3,430	
29	2.04	3,310	2.80	3,470	
30	2.49	3,030	2.91	3,690	
31			3.72	5,520	

[1] Interpolated.

I have made a very detailed study of all the available records at these two stations for the purpose of showing the variation in the flow of the Green and Colorado rivers in the stretch covered by my examination, and the relation of the flow at the time of my examination to the longer-time records. In view of the fact that many comparisons are made in this report between conditions at the time of my investigation and those existing when the Army engineer examinations were made in 1909 that a comparison

of the flow, in November, 1909 and the long-time records is also made, the results of these studies are shown on the tables which accompany this report [1] and which show for both the stations, the following:

(a) Mean annual run-off and variation therein; daily minimum and maximum flow by years and distribution of the annual run-off by months.

(b) Mean monthly discharge and variation therein; minimum and maximum daily discharge in each month and ratio between the minimum and maximum flows.

(c) Number of days in each year when the flow was below certain amounts.

(d) Average number of days in each month when the flow was below certain amounts.

Tables (a) to (c) are in common usage. As far as the writer knows stream-flow data have not heretofore been presented in a manner similar to (d). They show in the simplest possible manner a true picture of the stream-flow characteristics.

MEAN ANNUAL DISCHARGE

Green River at Greenriver, Utah.—Table page 71 (Appendix A) shows the mean annual discharge for the period covered by the records, the mean daily maximum, the mean daily minimum, discharge, and the distribution of flow by months. It will be noted that the mean flow is 7,600 second-feet with a range from a minimum yearly mean of 4,460 second-feet, or 59 per cent of the mean during 1919 to a maximum yearly mean of 12,400 second-feet, or 1.63 times the mean during 1907. The mean daily discharge has ranged from 510 second-feet to 67,300 second-feet.

[1] See Appendix A.

Colorado River near Cisco, Utah.—Data similar to that for Green River are shown on page 31 (Appendix A). It will be noted that the mean flow is 9,660 second-feet with a range from a yearly minimum of 6,940 second-feet, or 72 per cent of the mean during 1925 to a maximum yearly mean of 12,100 second-feet, or 1.25 times the mean during 1917. The mean daily discharge has ranged from 866 second-feet to 73,200 second-feet. On the basis of mean annual flow the Colorado River near Cisco is 1.27 times the Green River at Greenriver, Utah. The Cisco station does not cover an exceptionally dry year like 1919 nor a wet one like 1907, the mean, however, is believed to be comparable with the long-time mean for Green River.

The following table shows the average number of days in each month when the flow equalled or exceeded the mean flow:

Number of Days

Month	Green River	Colorado River	Month	Green River	Colorado River
October	+1	+1	April	16	14
November	0	0	May	30	30
December	0	0	June	28	30
January	0	0	July	18	20
February	−1	0	August	3	4
March	5	−1	September	2	+1

Based upon all past records during 8 months of the year, August to March, a flow equal to the mean flow has occurred on the average only 11 days on the Green River and 9 days on the Colorado, indicating that so much water runs off during the floods that the average for the year is raised to such an amount that studies based on mean annual flow do not indicate conditions during the greater part of the year.

MINIMUM FLOW

Green River.—The average of the minimum flow of Green River at Greenriver, Utah, for each year is 1,090 second-feet with a minimum mean day of 510 second-feet during 1920. The average flow during the period, September 29 to October 6, when my investigation was made of Green River between Greenriver, Utah, and the mouth of the San Rafael, was 1,690 and between October 10 and October 17, when my investigation was made between San Rafael River and the mouth of the Green, was 4,970 second-feet. The surveys by the Army engineers were made during November, 1909, when the mean flow for the month as computed from the records collected at the Green River gaging station near Greenriver, Utah, was 2,980 second-feet and only varied from a minimum of 2,470 second-feet to a maximum of 3,510 second-feet. The following table shows the average number of days in each month; the flow at Greenriver, Utah, has been below 1,680 second-feet and the average number of days below 4,970 second-feet.

	Below 1,680 s. f.	Below 2,980 s. f.	Below 4,970 s. f.		Below 1,680 s. f.	Below 2,980 s. f.	Below 4,970 s. f.
October	+1	12	28	May	0	0	+1
November	+2	19	29	June	0	0	−1
December	15	29	31	July	−1	2	8
January	15	29	31	August	+2	9	21
February	7	25	27	September	4	17	26
March	−1	8	21				
April	0	1	6		38	151	228

Flow giving rise to conditions similar to those described by me along Green River between Greenriver, Utah, and the mouth of the San Rafael River have occurred on the average about 48 days in each year scattered throughout all of the months, July to

March, and are seen not to be confined to any one definite period. Flow conditions resulting in conditions similar to that described by me along Green River between San Rafael and the mouth have occurred on the average of 228 days in each year scattered throughout all the months but more especially the months from August to March, inclusive.

Colorado River.—The average of minimum flows of the Colorado River near Cisco, Utah, for each year is 1,800 second-feet with a minimum mean day of 866 second-feet. The average flow for the Colorado River for the period October 18 to 23, 1928, during which time my investigations were made of the Colorado between the mouth of Green River and Castle Creek, was 4,900 second-feet. The Cisco station was not being operated during November, 1909. It is estimated that the flow was about 3,500 second-feet.

The following table shows the average number of days in each month when the flow of the Colorado River was less then 4,900 second-feet:

Month	Days below—		Month	Days below—	
	3,500 second-feet	4,900 second-feet		3,500 second-feet	4,900 second-feet
October	10	22	May	0	0
November	20	29	June	0	0
December	27	31	July	1	4
January	26	30	August	9	15
February	26	+27	September	12	21
March	22	27			
April	1	+3		154	205

It is seen that flows resulting in conditions similar to those described by me along the Colorado River between the mouth of the Green River and Castle Creek have occurred on the average about 205 days

each year and more especially during the months August to March, inclusive.

MAXIMUM FLOWS

The recorded maximum mean daily flow at Greenriver, Utah, has varied by years from 19,200 second-feet to 67,300 second-feet.

The recorded maximum mean daily flow on the Colorado River at Cisco has varied by years from 27,700 second-feet to 73,200 second-feet with an average mean daily maximum of 50,200 second-feet.

The following table shows the average number of days in each month when the flow of the Green and Colorado rivers has been above 10,000, 20,000 and 30,000 second-feet:

	Green River at Greenriver, number of days above			Colorado River near Cisco, number of days above		
	10,000	20,000	30,000	10,000	20,000	30,000
October	-1	0	0	+1	0	0
November	0	0	0	0	0	0
December	0	0	0	0	0	0
January	0	0	0	0	0	0
February	0	0	0	0	0	0
March	3	-1	-1	-1	0	0
April	6	-1	0	11	2	1
May	27	14	1	30	22	11
June	28	18	11	30	27	16
July	14	3	1	23	3	1
August	-1	0	0	0	0	0
September	1	-1	0	+1	-1	0

It will be noted that on both rivers floods exceeding 10,000 second-feet may occur in any or all of the 8 months, March to October, inclusive. Floods of 20,000 anf 30,000 second-feet magnitude are limited in general to the months of April, May, and July with occasional occurrences during March, August, and September.

Variation in flow by months.—The variation in flow by months for both the Green River and the Colorado is shown in detail on tables on pages 31 to 36 and 70 to 87.[2] For the purposes of ready comparison the principal features of these tables are herewith condensed. The headings used in the tables are defined as follows:

Mean = Average of all the mean discharges for the month.

Minimum mean = Mean discharge in the lowest month.

Maximum mean = Mean discharge in the maximum month.

Average minimum mean = Average of the lowest day in each month.

Minimum day mean = Lowest mean daily discharge in all the months.

Average maximum mean = Average of the maximum day in each month.

Maximum day mean = Maximum mean daily discharge in all the months.

Green River at Greenriver, Utah

Month	Mean	Minimum mean	Maximum mean	Average minimum	Lowest daily minimum	Average maximum	Maximum daily mean
October	3,250	1,710	4,950	2,430	1,240	5,200	12,000
November	2,660	1,380	4,320	2,000	710	3,350	5,870
December	1,770	861	2,720	1,180	510	2,570	4,820
January	1,770	1,000	2,800	1,500	930	2,920	4,380
February	2,290	1,200	4,910	1,790	1,200	3,830	8,640
March	5,070	2,000	11,400	2,500	1,450	10,700	33,000
April	8,570	4,070	14,000	4,940	2,720	14,900	24,900
May	20,700	11,000	43,500	10,300	4,580	32,000	67,300
June	26,200	9,250	46,700	17,100	3,620	38,800	66,700
July	11,300	3,750	21,600	6,050	870	19,500	59,400
August	4,560	1,200	11,200	3,020	838	7,120	19,300
September	3,420	1,300	9,960	2,180	834	6,820	27,500

[2] Appendix A.

Colorado River near Cisco, Utah

Month	Mean	Minimum mean	Maximum mean	Average mean	Lowest daily mean	Average maximum	Maximum daily mean
October	4,460	2,250	6,080	3,220	(2,000)	7,400	14,200
November	3,510	2,770	4,620	2,890	2,290	4,660	7,500
December	2,850	2,310	3,770	2,350	1,500	3,390	4,170
January	2,550	2,000	3,400	2,150	(1,600)	3,920	6,400
February	2,860	2,500	3,300	2,540	1,950	4,200	8,350
March	3,710	2,770	6,870	2,550	2,050	6,390	16,100
April	10,000	7,250	12,900	4,260	2,450	20,300	30,900
May	27,500	17,800	37,800	14,000	8,560	44,800	59,700
June	34,300	18,500	55,500	21,700	12,800	48,700	73,200
July	14,000	7,650	24,600	7,230	2,870	26,500	53,700
August	5,870	1,830	10,300	3,160	958	9,710	17,300
September	4,210	1,690	8,870	2,850	866	7,670	21,900

Comparison of flow of Green and Colorado Rivers.—Based upon mean annual flow the Colorado River near Cisco is about 25 per cent greater than the Green River at Greenriver, Utah. The preceding detailed study indicates, however, that for the month of March the Green River has a mean flow of 5,070 second-feet, compared to 3,710 second-feet for the Colorado River near Cisco, and that on the average the flow of Green River for 25 days during March exceeds the Colorado River. The records also indicate that during one April there was a lower daily minimum flow on the Colorado River than any minimum daily recorded on the Green. With respect to floods higher maxima have been recorded on the Green during February, March, August, and September than have been recorded on the Colorado during the same months.

With respect to variation in flow the records indicate that during the [7] months of January, April, May, June, July, August, and September there is a larger fluctuation between minimum and maximum flows on the Colorado than on the Green and that during the remaining six months the condition is reversed.

Index of variation.—The ratio of the maximum daily flow to the minimum daily flow in each month has been taken as a measure of the variation in flow. The average ratio and also the maximum that has occurred are shown in the following table for the two stations:

Month	Green River		Colorado River	
	Average ratio, maximum to minimum	Maximum ratio, maximum to minimum	Average ratio, maximum to minimum	Maximum ratio, maximum to minimum
October	2.22	7.80	2.30	3.97
November	1.68	3.88	1.61	2.15
December	2.18	6.03	1.44	2.04
January	1.75	3.77	1.82	3.88
February	2.14	6.25	1.65	4.28
March	4.28	11.66	2.51	5.86
April	3.02	7.78	4.77	7.63
May	3.11	10.50	3.20	5.60
June	2.15	5.50	2.25	3.33
July	3.22	5.81	3.66	5.30
August	2.36	4.22	3.07	3.63
September	3.13	6.03	2.69	9.10

To the extent that the ratio between the daily maximum and the daily minimum represents a variability of flow, the following table shows the months arranged in order of magnitude from the month of least variation to the month of most variation, based both on averages and extremes:

Green River				Colorado River			
Month according to average ratios		Month according to maximum ratios		Month according to average ratios		Month according to maximum ratios	
November	1.68	January	3.77	December	1.44	December	2.04
January	1.75	November	3.88	November	1.61	November	2.15
February	2.14	August	4.22	February	1.65	June	3.33
June	2.15	June	5.50	January	1.82	August	3.63
December	2.18	July	5.81	June	2.25	January	3.88
October	2.22	September	6.03	October	2.30	October	3.97
August	2.36	December	6.03	March	2.51	February	4.28
April	3.02	February	6.25	September	2.69	July	5.30
May	3.11	April	7.78	August	3.07	May	5.60
September	3.13	October	7.80	May	3.20	March	5.86
July	3.22	May	10.51	July	3.66	April	7.62
March	4.28	March	11.66	April	4.77	September	9.10

Physical Characteristics

On the basis of topograhy and other physical characteristics the stretches of the Green and Colorado rivers examined may be divided as follows for the purpose of this report:

GREEN RIVER

(a) Above the town of Greenriver, Utah.
(b) From Greenriver, Utah, to and including the mouth of the San Rafael River.
(c) Labyrinth and Stillwater Canyons (San Rafael River to mouth).

COLORADO RIVER

(a) From the head of Cataract Canyon to the mouth of the Green River.
(b) From the mouth of the Green River to Moab.
(c) From Moab to Castle Creek.

GREEN RIVER ABOVE GREENRIVER, UTAH

The Green River flows out of Gray Canyon, 12 miles above the town of Greenriver, Utah, and meanders southward across the plain south of the Book Cliffs on which the town is located. My personal examination covers only the lower 4 miles of this stretch. Here the river flows in a meandering channel ranging from about 700 to 1,000 feet in width between banks. With the exception of a shale outcrop, possibly 3,000 feet long, on the left bank in the vicinity of mile 118 [3] the banks consist of dirt ranging in height from 10 to 15 feet and are more nearly vertical than otherwise. Heavy gravel bars exist at miles 119.4,

[3] Mileage points are shown on the river survey sheets forming Plates 38 to 46.

119.9, and 121, causing decided riffles; elsewhere, as determined by the soundings, the bed of the river was sand. When speaking of riffles in this report, I have in mind the obstruction in the flow by sand or gravel bars of such magnitude that a head of between one and three feet will be created, in a distance of between 1,000 and 2,000 feet. The higher velocities due to the head, together with the roughness of the bed and the shallowness of the water, cause the surface of the water to break into waves two or three inches high.

When speaking of rapids I have in mind the obstruction in the flow by rock or boulder formation of such magnitude that a head of from three to ten feet and over will be created in a short distance. The rock in the channel is frequently of such size that they project above the surface of the water. The water flows over these obstructions with very high velocities and the energy in the falling water is dissipated by standing waves several feet in height. As compared with the low murmur of a riffle, the roar of a rapid can be heard for thousands of feet.

The channel at the riffle shown in photograph 10 was so shallow and rocky that it limited the upstream trip with the rowboat and the outboard motor. As indicated in the photograph, this riffle is caused by a long diagonal crossing bar composed of cobbles and coarse gravel. (Crossing bars are defined and their formation discussed on pages 41 and 64.) According to the 1914 river survey the total fall in the 4-mile stretch is 16 feet, or at the rate of 4 feet to the mile. It is estimated that fully half of the total fall is concentrated at the three riffles. The depths in the channel between the riffles ranged from 1 to 7 feet, the most usual depth being between 2 and 3 feet. The depths of water across the channel at the riffles,

was in most instances less than 1 foot, although in the thread of the current the depths were about 2 feet. Velocities were estimated to range from 1 or 2 miles an hour between the riffles, to possibly 6 or 7 miles an hour in the riffles. Except at shale outcrops and possibly the gravel bars at the riffles, it is evident that there is no permanency in the flow channel location and probably not in the river bed. When describing channel or flow channel, I have in mind the actual channel occupied by water at the time of my investigation. By flood channel is meant the entire cross section that will be occupied by water during flood periods. Repeated detailed surveys would be necessary, however, to determine the exact extent of its changeability. Wherever the earth bank was subject to the thrust of the current I observed that it was being undermined and slumping into the river. Some idea of the magnitude of the changes taking place may be obtained from my observations, from statements by Mr. Blake, who accompanied me, and from a comparison of the General Land Office survey plat, approved June 9, 1883, and the river survey made in 1914 by the United States Bureau of Reclamation. The extent of change of location of the channel is clearly illustrated by photographs 8 and 9, made by me on September 30 on the right bank near mile 121, 4 miles above the town of Greenriver. According to Mr. Blake there was in 1916 a large hay field and a highway bordered by cottonwood trees between the brick house shown in these photographs and the river. As shown in the photographs the river is now undermining the house and the river now occupies the place where the hay field and road used to be. It is believed that within a period of probably two or three years

the river has cut back from the line of brush shown at the right in photograph 8.

During the spring of 1928 apple trees had been cut and piled along the bank where it received the thrust of the current in an endeavor to stop the cutting. These are indistinctly shown in photograph 8. On the left bank, opposite the bend, the bank is building up. Photograph 9, taken just below the house, shows large cottonwood trees being undermined. These two pictures are typical of the changes effected in dirt banks in the four-mile stretch above Green River where they receive the thrust of the current.

The location of the Green River as shown on the General Land Office plat of T. 21 S., R. 16 E., Salt Lake Meridian, approved June 9, 1883, indicates that changes of large magnitude have occurred in the vicinity of Sec. 10. On this plat the old settlement of East Blake is as shown on the east side of the river in lot 4, Sec. 10. (See pl. 3 for approximate location as shown by these surveys.) It is estimated that the river is now fully 2,000 feet east of this point.

The map of the river survey in 1914 by the Bureau of Reclamation shows a large island in Secs. 10 and 15. According to Mr. Blake, in 1909 the channel to the right of this island was the main channel. At the time of my investigation there was little indication of an island. What was the right channel has been filled up nearly level with the main bank, and there will be an island at this point only during periods of exceptionally high water. Photograph 2 is a view looking north from the Greenriver highway bridge directly at what used to be the lower end of the island and at the point where the outlet of the right channel used to be. The changes described above and which are

believed to have taken place in Sec. 10 are such as may be expected in a river flowing on an alluvial plain. Apparently in 1883 there was one well-defined channel conforming approximately with the right-hand channel shown on the river survey map of 1914. A small slough is shown in the S½, Sec. 10, but no left-hand channel. Some time between 1883 and 1914 the river cut through the slough and formed an island. Between 1909 and the present time the old main channel has been filling up, and at the time of my investigation there is only one channel.

GREEN RIVER FROM GREENRIVER, UTAH, TO AND INCLUDING MOUTH OF SAN RAFAEL RIVER

In the stretch of 22.4 miles between the mouth of the San Rafael River, mile 95 and the railroad bridge at Green River [Greenriver], Utah, mile 117.4 (see pls. 38, 39, and 40) the characteristics of the river are, to some extent, different from those above. In general terms, the river leaves the plain in which the predominating rock is shale and starts cutting its way through a series of sandstones and accompanying formations. The river does not flow in a continuous channel made up of these sandstones and it is only occasionally that the bare rocks form the bank of the river. Where this occurs, or where the bank is a talus of shale or heavy gravel, the channel and bank conditions are fairly permanent. It was expected that some clearly evident relation might be observed between the location of the bars and riffles and the several geologic formations. Some of the bars and riffles clearly owe their origin to the results of side tributaries and washes, and other geologic conditions perhaps play in important part.

The total drop in the 22.4 mile stretch, according to the river survey of 1914, is 59 feet, or at a rate of 2.6 feet to the mile. Of the total fall approximately 37 feet is concentrated at fifteen riffles having a total length of 4.0 miles and an average drop of 9.3 feet to the mile. The average fall in the 18.4 miles of the channel length between the riffles is 1.57 feet to the mile, corresponding to an average rate of 1.15 feet below the mouth of the San Rafael.

The investigations in this stretch were confined largely to the riffles and crossing bars of each of which plane-table surveys and photographs were made. Between the riffles and crossing bars the channel depths and bed and channel characteristics were observed in a general way. The riffles and crossing bars that were surveyed are listed below in downstream order:

Bars and riffles in Green River from Greenriver, Utah, to San Rafael River

	Miles above mouth	Mile below bridge at Green River, Utah	Miles above Lees Ferry, Ariz.
Browns bar and riffle	117.1	0.2	333.6
Mobre bar and riffle	116.5	.8	333
Twomile bar and riffle	115.5	1.8	332
Butterfly bar and riffle	114.5	2.8	331
Auger bar and riffle	112.5	4.8	329
Farrer bar and riffle	111	6.3	327.5
Cable bar and riffle	109.9	7.4	326.4
Crossing bar at mile 109	109	8.3	325.5
Halverson riffle	108.5	8.8	325
106.7 mile bar and riffle	106.7	10.6	323.2
Gimlet bar and riffle	106	11.3	322.5
Sunabs bar and riffle	104	13.3	320
Second Anvil bar and riffle	101.5	15.8	318
First Anvil bar and riffle	100	17.3	316.8
San Rafael bar and riffle	94.9	22.4	311.4

Length of riffles and fall per mile of Green River, Green River [Greenriver], Utah, to San Rafael River

	Miles above mouth	Length in miles	Fall in feet	Fall per mile
Browns bar and riffle	117.1	0.23	3.0	13
Mohre bar and riffle	116.5	.14	2.0	15
Twomile bar and riffle	115.5	.34	2.0	6
Butterfly bar and riffle	114.5	.28	2.5	9
Auger bar and riffle	112.8	.30	3.3	11
Farrer bar and riffle	111	.25	3.0	12
Cable bar and riffle	109.9	.19	1.7	9
Crossing bar at mile 109	109	.15	1.3	9
Halverson riffle	108.5	.44	4.0	9
106.7 mile bar and riffle	106.7	.21	2.2	10
Gimlet bar and riffle	106	.19	4.2	22
Sunaba bar and riffle	104	.37	3.2	8
Second anvil bar and riffle	101.5	.27	2.8	10
First anvil bar and riffle	100.0	.23	1.6	6
San Rafael bar and riffle	94.9	.11	0.3	.3
Total and average		3.97	37.4	9.3

BROWNS BAR AND RIFFLE (MILE 117.1)

Saleratus Wash, which drains a considerable area lying to the west of the Green River, empties into the river just below the railroad bridge at Greenriver, Utah. A survey of the bar and riffle at this point was made September 29, 1928. (See pl. 4.) The mean discharge at Greenriver gaging station on September 29 was 1,780 second-feet. The river was falling from the peak flow of 19,800 second-feet at 9 p. m., September 27. As shown on Plate 4, a bar 2,200 feet long and 1,500 feet wide has been built up at the mouth of the wash, forcing the Green River against the left bank in a flow channel ranging in width from 150 to 400 feet, as compared to a channel width of 650 feet just above the bar. The material in the bar is coarse gravel and cobbles at the upper end, grading to fine sand and mud at the lower end. (See photographs 6 and 7.) Here, as in most of the other bars the material shows wide differences in character [in] very short distances. The lower central

part of the bar is 8 feet above the water level but the greater portion lies only between 1 and 2 feet above the water. The riffle created by the bar has a drop of nearly 3 feet. (See photographs 13 and 103.) The channel bed of the riffle is heavy gravel with many large rocks some of which are exposed and others are of sufficient size to form waves. The only permanent features in the vicinity of Browns Bar are the low sandstone outcrops on both banks at the lower end of the bar. Elsewhere the banks are cutting and subject to change. Photographs 1 and 5 show the cutting banks up Saleratus Wash. Photographs 6 and 7 show a portion of the left cutting bank; the right bank of the flood channel has similar characteristics.

It is to be expected that there will be a gradual widening of the flood channel with possibly a building up of the central portion of the bar into an island. The bar, lying as it does directly in the path of floods in the Green River may, during such periods, be washed away. It is clearly evident that each successive flood in Saleratus Wash will build the bar up again. The changes that have taken place between November 23, 1909, and September 29, 1928, indicate the probable trend of future changes.

The mean daily discharge as published for the Green River gaging station when the Army Engineers' investigations were made on November 23, 1909, was 2,700 second-feet. A comparison of the physical conditions then and now is shown on Plate 5. Plate 5 and other similar plates comparing conditions in 1909 and at the time of my investigation were made by photographic reproduction of the blue print maps furnished by the Army Engineer to a scale of 1 inch = 500 feet and reproducing the outline of the bar and

channel on the plate. The outline of my surveys are shown for comparative purpose. The number of the photographs and the direction taken are shown by circles, numbers, and arrows. It is clearly evident that the flood channel has widened very appreciably, amounting to a maximum of 500 feet. The bar itself is of about the same general shape although it has been widened about 400 feet since 1909. The maximum cutting has apparently occurred on the right bank below the mouth of Saleratus Wash.

The bed of the flow channel at the riffle consists of such coarse material that it probably does not change materially. However, owing to the widening of the flood channel the average depths for the same flow conditions would probably be materially less in 1928 than in 1909. The widening of the Green River flow and flood channel which is clearly shown to have taken place at most of the bars and riffles between Greenriver, Utah, and the mouth of the San Rafael River, makes it difficult to determine any relation between the 1909 stream flow and channel depths and present stream flow and channel depths.

The flood channel of Saleratus Wash ranges in width from 150 to 300 feet and has an average depth of about 10 feet, giving an average cross section of 1,750 square feet. The discharge after storms striking its basin may possibly exceed 15,000 second-feet. The 12-foot dirt bank along the north side of the wash shows marked signs of cutting during the flood of September 27, 1928. The material brought in by Saleratus Wash has undoubtedly enlarged and built up Browns Bar, which now contains about 300,000 cubic yards of material. As it is roughly estimated that storms occurring up the wash may result in floods which will dump into Green River a million

cubic yards, an idea can be obtained of the amount of sediment moving in suspension and as bed load in the main stream during any single flood period. (For a more complete statement of the amount of silt and débris carried in suspension and as bed load see page 76.)

MOHRE BAR AND RIFFLE (GREEN RIVER, MILE 116.5)

Mohre Bar and Riffle occur in a stretch of the Green River about 0.8 mile below the railroad bridge at Greenriver, Utah, and 116.5 miles above the mouth. The river in this stretch has a tendency to bend to the left. A plane-table survey was made of the bar and riffle on October 1, 1928. (See pl. 6.) The mean discharge at Greenriver on this day was 1,930 second-feet. The flow channel at the bar was between 250 and 300 feet wide. The exposed sand and gravel bar on the right bank had a maximum width of about 300 feet and a length of 1,500 feet. The one on the left bank had a maximum width of 600 feet and a length of 2,000 feet. The bed of the channel at the riffle was made up of heavy gravel containing many rocks, a number of which were exposed. The only permanent feature in the vicinity is an outcrop of sandstone and conglomerate on the right bank at the lower end of the riffle. Elsewhere the banks were observed to be dirt and are subject to cutting. (See photographs 14, 104, and 105 for general views of the bar, riffle, and banks.)

An increase in the height of the water of 3 or 4 feet will submerge the side bars and cause bank cutting, especially along the right bank which will receive the thrust of the current. A comparison of the bar conditions as they existed on November 23, 1909 (A, pl. 7), as shown by the Army Engineers' survey and as they

existed on October 1, 1928 (B, pl. 7), indicates what change may be expected. On November 23, 1909, the flow at Green River, Utah, was 2,700 second-feet. As shown on plate 7 there were two distinct flow channels. According to notes accompanying the Army Engineers' map the left channel was estimated to be taking 62 per cent of the flow. The central part of the large island was noted to be at a high-water level and had on it a growth of willows. At the time of my investigation in 1928 there was only one channel, and only a very small part of the bar that was an island in 1909 was more than 2 or 3 feet above the water surface. Although both banks are dirt and showed signs of cutting there has apparently been little change in width of the flood channel. The principal change seems to have been a filling in what was the left channel and a partial cutting away of much of the higher portions of the island bar. It is possible that in the future these conditions may be reversed and the bar revert to the 1909 conditions. With the river bending from right to left the most usual condition would be for a bar to be formed on the inside or left bank and for the main channel to follow the outside or right bank. This was the general condition in October, 1928.

TWO-MILE BAR AND RIFFLE (GREEN RIVER, MILE 115.5)

Two-mile Bar and Riffle are about 115.5 miles above the mouth of the Green River, 1.8 miles below Greenriver, Utah, in a stretch where the river bends to the right. A plane-table survey (see pl. 8) was made on October 1, 1928. The mean discharge at Green River on this day was 1,930 second-feet. The channel at this point was found to be split by an island 1,850 feet long, 500 feet in maximum width,

and 15 to 20 feet in maximum height above the water surface. A strip 1,300 feet long and 250 feet wide at the lower end of the island was covered with a dense growth of willows, among which were at least 5 large cottonwood trees. Approximately three-fourths of the total discharge was in the right channel and one-fourth in the left channel, both of which have an average width between 150 and 200 feet. The maximum width of the flood channel was 1,850 feet, practically the same as that of the Hohre Riffle. A decided riffle with a drop of about 1½ feet occurs in the channel at the head of the island. The bed of the channel at this point was gravel and cobbles. Except for a narrow channel about 15 feet wide between the right bank and a small island the depths in the riffle in both channels was less than 1 foot. The right bank consists of a sandstone and talus slope for 1,400 feet. With the exception of a sandstone outcrop about 500 feet long at the lower end of the island (see photograph 15), the left bank consists of dirt and gravel about 10 to 12 feet high and appeared to be cutting somewhat. Photograph 16 shows some interesting holes which appeared in the mud on the island after the recent high water. It is believed that these holes were caused by escaping gas resulting from the decomposition of vegetable matter. Similar conditions were observed by H. D. Miser along the Colorado between the San Juan River and the Hole-in-the-Rock.[4] At no other places along either the Green or the Colorado did I observe these conditions.

On November 24, 1909, a survey of the bar was made by the Army Engineer Corps. A comparison

[4] The San Juan Canyon by Hugh D. Miser, Water Supply paper No. 538.

of the conditions at the bar then and in 1928 is shown by Plate 9. The mean discharge on November 24, 1909, at Greenriver, Utah, was 2,820 second-feet. The main channel then followed the left bank, and the statement accompanying the map indicates that very little water was flowing in the right channel. At the time of my investigation the right channel was the main channel and carried the greater part of the flow. Apparently at one time the island was a bar attached to the right bank. A channel was gradually cut through next to the right bank, forming an island, and it is not improbable that in time the left channel may entirely fill, although under ordinary conditions it is to be expected that the left channel, being on the outside of the bend, would maintain itself as the main channel.

BUTTERFLY BAR AND RIFFLE (GREEN RIVER, MILE 114.5)

Butterfly Bar and Riffle are about 114.5 miles above the mouth of the Green River, 2.8 miles below the railroad bridge, in a stretch where the river is bending from right to left. A plane-table survey (see pl. 10) was made by the writer October 2, 1928. The river was dropping somewhat, the mean flow at Greenriver, Utah, being 1,680 second-feet for the day. The channel at this point was separated by an island 1,500 feet long and 300 feet wide. A part of the lower end of the island, 1,000 feet long and 200 feet wide, had a maximum height of about 15 feet and was covered with willows. The remainder of the island was sand and gravel. The left channel carried about 80 per cent of the flow and had an average width of 400 feet. The right channel was only about 100 feet wide and was shallow. A coarse gravel bar extended diagonally across the left or main channel,

creating a riffle having a total drop of nearly 3 feet. The maximum depth on the bar may be between 2 and 3 feet, but in most places it was observed that depth was less than two feet.

Photograph 17 shows the right channel at the bend of the island, and photograph 106 the left channel and a part of the island.

On November 25, 1909, a survey of the bar was made by the Army Engineer Corps. A comparison of the conditions then and now is shown by plate 11. The mean discharge at Greenriver [Greenriver, Utah] on November 25, 1909, was 2,950 second-feet. Conditions at the time of my investigation were not materially different. The left channel has widened somewhat but is still the main channel. The right channel has widened materially. It seems very plausible that the island was once an ordinary sand bar attached to the left bank and that a channel was cut through the bar forming an island. With the exception of the willow-covered bar on the left bank the outside of the channels now abut against rock, and the total width of the channel is therefore well fixed. In all probability the island will change in shape, and the right end of the crossing bar forming the riffle wash out since they will receive the full thrust of the current during flood stages.

AUGER BAR AND RIFFLE (GREEN RIVER, MILE 112.5)

Auger Bar and Riffle are about 112.5 miles above the mouth of the Green River, 4.8 miles below the railroad bridge, in a stretch where the general trend of the river is from left to right. A plane-table survey (pl. 12) was made by the writer October 2, 1928. The mean discharge on this day at Greenriver, Utah, was 1,680 second-feet. Conditions here were found to be

similar to those at Browns Bar and at the mouth of the San Rafael River. An immense bar, best shown by photograph 107, 1,100 feet wide and 2,000 feet long, has been built up at the mouth of a wash coming in from the left. A part of the bar 700 feet long and 150 feet wide has been built up to a height of 10 feet and was covered with willows. The remainder of the bar was sand and gravel from 2 to 4 feet above the water surface, across which several flood channels have been cut. Angular rock fragments are prevalent in the gravel at the head of the bar indicating that they have not been exposed to the water for a long enough time to become water worn. The bar has forced the river directly against the right rock wall, which at the lower end of the river bends to the right. This wall receives the full thrust of the current, and during flood stages powerful eddies and whirlpools undoubtedly occur, giving the bar its name. The low-water channel is less than 200 feet wide compared to a flood channel width of 1,300 feet. The bed of the channel consists of gravel and many exposed rocks, and according to Mr. Blake many lay just under the water surface. There was a drop of 3 feet at the riffle with a fairly high velocity estimated to be between 4 and 6 miles an hour.

Photograph 18 shows the coarse material on the bar, photograph 19 the cutting channel of the wash, and photograph 107 a general view of the bar and channel.

The right bank is rock and is permanent. The left bank was dirt and showed evidence of extreme cutting.

On November 25, 1909, a survey was made by the Engineer Corps. A comparison of the conditions at the bar then and now is shown by Plate 13. The

discharge at Greenriver, Utah, on November 25, 1909, was 2,950 second-feet. It is apparent that the wash continues to bring in more material than is being carried away by the river, thus the bar is maintained against the force of the current. A very decided medium and high-water channel has been cut through the bar next to the left bank, and it is to be expected that at some future time the bar will take the form of an island. The flood channel will tend to widen as a result of cutting of the left bank, and probably the center of the bar will be built up.

FARRER BAR AND RIFFLE (GREEN RIVER, MILE 111)

Farrer Bar and Riffle are about 111 miles above the mouth of the Green River, 6.3 miles below the railroad bridge, in a straight stretch of river running about due west. A plane-table survey (see pl. 14) was made by the writer on October 3, 1928. The mean discharge at Greenriver, Utah, on this day was 1,590 second-feet. The Farrer Bar is believed to be a typical so-called crossing bar, having been built up to a point where it is nearly all exposed and forms a decided obstruction to the flow. The bar had a length of 3,000 feet and the main approaching channel a width of only 600 feet. Naturally, as a result of the length of the bar, the water flows over it with very shallow depths and fairly high velocity, owing to the 2-foot head created. The bed of the channel at the riffle, as well as most of the exposed bar, was heavy gravel. The side banks were generally sloping and were not being cut materially. (See photographs 20, 21, 108, and 109.) A part of the lower end of the island has been built up to a height of 10 feet and is being cut along the right edge. Depths in most places across the bar were estimated to be less than 1 foot, and the

maximum was probably less than 2 feet—at least Blake took the row boat through what was apparently the deepest place and there was little clearance.

On November 26, 1909, a survey of the bar was made by the Army Engineer Corps. A comparison of the conditions at the bar then and now is shown by Plate 15. The mean discharge at Greenriver, Utah, on November 26, 1909, was 2,700 second-feet. According to the notes accompanying the survey of 1909 the right channel was used by the boats, although it is stated that the left channel was believed to be better on account of low velocities. The head of the left channel at the island in October, 1928, was so shallow that it could not have been used by the row-boat. In general it does not appear that conditions are materially different now than in 1909. The main island is of about the same size and shape. Conditions below the island have changed somewhat. This crossing bar is about equidistant between two bends of the river, two miles apart. The reason for the bar at this particular location can not be determined without the most detailed observations covering all flow conditions. It has, apparently, maintained itself in the same general location for nearly 20 years and may continue indefinitely.

CABLE BAR AND RIFFLE (GREEN RIVER, MILE 109.9)

Cable Bar and Riffle are about 109.9 miles above the mouth of the Green River, 7.4 miles below the railroad bridge in a stretch at a decided bend in the river from right to left. A survey was made by the writer on October 3, 1928 (pl. 16). The discharge at Greenriver on that day was 1,590 second-feet. The bar was about 1,400 feet upstream from the old ferry cable, which is now used as a gaging station

cable. An island bar 1,500 feet long and 400 feet wide has been built up, creating a decided riffle having a drop of nearly 2 feet. This bar and riffle were not surveyed or discussed in the report on the investigation of 1909 by the Army Engineer Corps, nor is it shown on the map of the survey made in 1914 by the United States Reclamation Service. They are therefore assumed to be of fairly recent origin. The main low-water channel lying to the right of the island, was about 300 feet wide. The left channel was observed to be very shallow. The flood channel was 850 feet wide. Apparently the island was formed out of an ordinary inside bar through which a channel was cut next to the left bank. The island material was coarse sand and gravel and has been built up to a height of about 5 feet above the water surface. Photograph 110 is a general view looking across the right channel and the island. The lower right channel abuts against a rock bank and is permanent. The left bank at the island is dirt and was being cut; below the island the bank is sloping and gravelly and will resist the action of the water to a very considerable extent. The flood channel has apparently widened to take care of the island and it is possible that the island may be further built up, with perhaps some additional cutting of the left bank.

CROSSING BAR, GREEN RIVER AT MILE 109

At 109 miles above the mouth of the Green River and 7.4 miles below the railroad bridge there was at the time of my study a coarse gravel bar extending diagonally across from the upstream corner of an exposed sand and gravel bar on the right bank. (See pl. 17.) On October 4, 1928, the mean daily discharge at Greenriver was 1,550 second-feet. Fol-

lowing the bar as closely as possible, I made a cross section beginning with the left bank from which the depths listed below were obtained:

Distance from left bank	Depth	Distance from left bank	Depth	Distance from left bank	Depth
Feet	*Feet*	*Feet*	*Feet*	*Feet*	*Feet*
0	[1]0.0	200	1.5	600	1.1
25	.85	225	1.55	625	1.0
50	1.5	250	1.6	650	.8
75	2.1	275	1.7	675	1.
100	1.9	300	1.6	700	1.3
125	1.5	325	1.5	725	.7
150	1.7	350	1.2	740	[2]0.

[1] Assumed elevation of water surface 100.0 feet.
[2] Elevation referred to assumed elevation at left bank 99.1 feet.

Photograph 111 is a view looking downstream and across the bar and photograph 22 shows our boat crossing the bar.

This bar has formed at an angle of about 60° and has a length of about 50 per cent greater than the section perpendicular to the channel.

These diagonal crossing bars are analogous to long, diagonal dams or weirs across the river and because of their length they pass the flow with depths from one-half to one-third of that in the approaching channel. With particular reference to the bar at mile 109 the average depth on the bar was 1.2 feet. Even assuming that the velocities were as high in the approaching channel as over the bar a mean channel depth of 2.5 feet or twice as much as at the bar would obtain in the approaching channel. Many of these bars—for example, the Farrer—are at a much smaller angle to the thread of the channel with a correspondingly greater difference between the average depth in the approaching channel and the average depth over the bar. It is evident that

as the flow of water drops the crossing bars will form an increasing barrier to the flow, and under these conditions it is to be expected that a definite low-water channel will be developed across the bar rather than a widely spread out flow. On a rising stage the bars of finer material such as are found below the San Rafael River or along the Colorado River between Moab and the mouth of the Green River, and probably to a lesser extent the heavier gravel bars above the mouth of San Rafael River, may be partially washed out, the extent of the washing depending upon the velocity and the size of sediment forming the bar. On the succeeding falling stage the nucleus of a new bar will be formed, its magnitude depending among other things on the character of material that is being moved downstream in suspension or as bed load.

I have concluded from my observations and studies that in so far as crossing bars are concerned during long periods of low flows such as may occur during the winter periods an easily discernable channel may be cut through them but that with any appreciable increase in flow the apparent location of the channel is obliterated and that between each successive low-flow period there is no semblance of a definite channel across them.

HALVERSON BAR AND RIFFLE (GREEN RIVER, MILE 108.5)

Halverson Bar and Riffle are immediately downstream from Milkshake Creek, 108.5 miles above the mouth of the Green River, 8.8 miles below the railroad bridge, in a relatively straight stretch of the river. A plane-table survey (see pl. 18) was made October 4, 1928, by the writer when the mean discharge at Greenriver was 1,550 second-feet. Con-

ditions at this bar were found somewhat different from those that occur elsewhere on the Green River at the mouths of creeks and washes. There is no extensive exposed bar such as exists at the mouth of Saleratus Wash. Apparently the carrying capacity of the river at this point is sufficient to transport all the finer material that is brought into the channel, leaving only the coarser material to be deposited. As a result two submerged bars have been built up, consisting of coarse gravel, cobbles, and comparatively large rocks. One of these was just below the mouth of Milkshake Creek and creates a head of somewhat over 1 foot, the other is about 2,000 feet below the mouth of the creek and creates a head of 1.5 feet. At both of these bars the channel was very shallow being barely sufficient in the deepest part to float the rowboat. (See photograph 23.) The right bank for a distance of 1,500 feet and the left bank for 2,000 feet is dirt and was being cut somewhat. Sloping gravel between the base of the banks and the water apparently stabilizes bank conditions. Shale crops out on the right bank for 1,400 feet and on the lower left bank for 500 feet.

On November 27, 1909, a survey of this bar was made by the Army Engineer Corps. A comparison of the conditions then and now is shown by Plate 19. The mean discharge at Greenriver, Utah, on November 27, 1909, was 2,700 second-feet. Notes accompanying the survey indicate that the most prominent feature of the bar in 1909 consisted of the rocks in the channel. Similar conditions were noted at the time of my investigation. Conditions appeared to be much the same in October 1928 as they were in 1909, and it is not expected that changes of any

great magnitude will occur in the future. It is to be expected that if there should be a storm in the basin of Milkshake Creek occurring at a time when Green River is low that an exposed bar might be temporarily built up. On the other hand Milkshake Creek may drain an area largely devoid of easily erodible material which accounts for the absence of typical bar formation.

BAR AND RIFFLE, GREEN RIVER AT MILE 106.7

At mile 106.7 above the mouth of the Green River, and 10.6 miles down-stream from the railroad bridge, a crossing bar has been built up, creating a fall of over 1½ feet in a distance of 700 feet. A survey was made of this bar by the writer on October 4, 1928 (see pl. 20), when the discharge at Green River was 1,550 second-feet. This bar had a length of about 1,200 feet compared with an approaching channel width of 500 feet. The depth over the bar is less than 1 foot in most places. This bar and riffle were not surveyed by the Army Engineers in 1909 and are therefore assumed to be of fairly recent origin. The right bank consists of coarse material and will probably maintain itself. The left bank consists of dirt and was being cut somewhat. Photograph 112 is a general view of the channel and bar, and photograph 24 is a view looking across at the head of the riffle. The very shallow depths across the diagonal bar are indistinctly shown in photograph 112. Close inspection will show that in this particular location the bed of the river is practically all exposed and this condition applies to many other locations where crossing bars exist.

GIMLET BAR AND RIFFLE (GREEN RIVER, MILE 106)

Gimlet Bar and Riffle are about 106 miles above the mouth of the Green River and 11.3 miles below the railroad bridge at Greenriver. A plane-table survey (see pl. 21) was made October 4, 1928, when the mean discharge at Greenriver was 1,550 second-feet. The river above and below the Gimlet is practically straight, and it is believed that the existing conditions are the result of a crossing bar being built up to a point where the low-water channel has been restricted to a width of 150 feet, through which it is estimated that 70 per cent of the water was flowing directly against a rock outcrop on the right bank. Photograph 113 shows the channel between the two islands. There was a drop of about 2.3 feet at the riffle, the channel was strewn with rocks, and the current on striking the right bank made a right-angle turn, causing a decided eddy. Conditions at this point must be greatly aggrevated during high-water periods. Below the Gimlet Riffle proper the channel was separated by an exposed sand and gravel bar 2,200 feet long and 250 feet wide. This bar had a maximum height of about 4 feet above the water. The left-hand channel had about a 1-foot drop and carried about 20 per cent of the flow. The total width of the channel below the Gimlet Riffle was 650 feet, compared to about 1,200 feet above the bar and riffle. The island above the Gimlet Riffle has been built up to a point where it is 15 feet above the water, 300 feet wide, and was thickly covered with willows. Photograph 113 gives a general view of the channel and islands, and photograph 25 shows a part of the lower island.

On November 27, 1909, a survey of the bar and riffle was made by the Army Engineer Corps. The

flow at Greenriver, Utah, on this date was 2,700 second-feet. A comparison of conditions then and now is shown by Plate 22. Accord to notes accompanying the survey of 1909 it is concluded that the main channel was about the same as now. In view of the fact that the bar and riffle have had the same characteristics for about 20 years, there seems to be no good reason to expect a radical change. The flood channel at this point is confined between rock walls, and any changes that occur will be in the size and shape of the island bars which change will naturally affect the channel and riffle.

SUNABA BAR AND RIFFLE (GREEN RIVER, MILE 104)

A survey (see pl. 23) was made by the writer October 5, 1928, of the so-called Sunaba Bar and Riffle, about 104 miles above the mouth of the Green River and 13.3 miles below the railroad bridge. The mean discharge at Greenriver on this day was 1,540 second-feet. At this point a bar 3,000 feet long and between 300 and 400 feet wide had been formed along the left bank. A narrow strip of the bar 900 feet long had been built up to a height of 10 to 12 feet and was covered with willows. The bar has forced the channel against the right bank, which consisted of a long talus slope. The average width of this channel was about 300 feet and the fall was slightly over 3 feet in 3,000 feet. Channel was estimated to be from 1 to 3 feet deep but the outstanding feature was the large number of submerged rocks in the channel. The Hughes investigation of 1909 noted rocks in the channel at this location, but apparently at that time the bar had not been built up to a point where it caused a decided channel contraction. The channel conditions, as they existed on October 5, 1928, are clearly shown in photograph 26.

SECOND ANVIL BAR AND RIFFLE (GREEN RIVER, MILE 101.5)

Second Anvil Bar and Riffle are 101.5 miles above the mouth of the Greenriver and 15.8 miles below the railroad bridge, at a point where the river makes a decided bend from right to left. A survey (see pl. 24) was made on October 5, 1928, when the mean discharge at Greenriver was 1,540 second-feet. At this point there was an exposed island bar 2,200 feet long with a maximum width of 700 feet. The main channel was about 200 feet wide and was being forced by the bar against the right rock wall. Fully 98 per cent of the flow was estimated to be carried in this channel. The left bank was from 15 to 17 feet high and was being cut. A small channel less than 100 feet wide and carrying 2 per cent of the flow abutted against the left bank. The greater part of the island was from 1 to 5 feet above the water except at the extreme lower end, which was fully 20 feet above the water. Photograph 114 is a general view of the bar, and photograph 27 shows a detail of the lower end of the bar.

At the riffle there was a drop of nearly 3 feet, velocities were high, and the channel contained many large rocks. On November 28, 1909, a survey of the bar was made by the Army Engineer Corps. The flow at Greenriver, Utah, on that day was 2,950 second-feet. A comparison of conditions then and now is shown by Plate 25. The small center channel shown in 1909 has been filled in; otherwise, the conditions appear to be identical. It is believed that the bar is one of the typical bars on the inside of a bend which has been cut through by a channel, forming an island.

FIRST ANVIL BAR AND RIFFLE (GREEN RIVER, MILE 100)

First Anvil Bar and Riffle are located 100 miles above the mouth of the Green River and 17.3 miles below the railroad bridge. A survey (see pl. 26) of this bar and riffle was made on October 5, 1928, when the discharge at Greenriver was about 1,540 second-feet. The exposed bar was in the form of an island 2,200 feet long with a maximum width of 500 feet. A narrow strip at the lower end was covered with willows and was from 12 to 15 feet above the water. (Photograph 29 is a view looking toward the lower end of the bar from the wooded portion.) The upstream portion of the bar was made up of cobbles and coarse gravel, grading to sand at the lower end. (See photograph 28.)

The right channel was taking fully 75 per cent of the discharge. At the heads of both channels were very coarse gravel bars creating decided riffles, the drop in the main channel being about 1½ to 2 feet. This bar is in a bend of the river from left to right. It is possible that the bar was formed as the ordinary inside bars and that after it was built up a channel was cut through which is now the main channel. In high water the left or outside channel is probably the main channel. The right bank of the channel is a sheer sandstone cliff for 1,100 feet, below which the bank was mantled with sand dunes. The left bank is a 12-foot dirt bank for 1,200 feet, below which a sandstone cliff predominates. The sandstone outcrops are permanent and confine the river rather definitely. The left dirt bank was being cut back gradually. The bar conditions are changing, but rather slowly, as is shown by a comparison of the conditions existing on November 21, 1909, when the investigation of the Army Engineers was made, and

at the date of my investigation. The flow at Greenriver on November 21, 1909, was 2,470 second-feet. As shown in A, Plate 27, the general character was the same in 1909 as now. During low-water periods at least, the right-hand channel has remained the main channel. The left-hand channel was shallow in 1909 as it is now. The bed of the river has remained composed of cobbles and gravel. The greatest change has taken place on the island. According to the survey in 1909 the surface of the island was covered with willows and most of it was at high-water level. Now the greater part of the island has been washed away, leaving only a small part willow-covered.

SAN RAFAEL RIVER BAR AND RIFFLE

The San Rafael River is the largest tributary to the Green River below the Price River and practically the only tributary below the town of Greenriver, Utah. The mean annual discharge is nearly 200,000 acre-feet or about 3½ per cent of the flow of the Green River. It is assumed that it is similar to all rivers draining arid, desert country and that it transports, especially during flood periods, large quantities of silt. At the mouth of the river a part of the material transported by the San Rafael has formed a bar (see pl. 28, based on survey made October 6, 1928), which had an extreme length of 2,600 feet and a width of 500 feet. This bar had, at the time of my investigation, an average height of less than 1 foot above the river and was composed of sand, with some gravel near the upper part. A portion of the upstream part of the bar is shown in photograph 32. Many portions of the bar were of quicksand on which it was dangerous to walk. The flow at Greenriver

at the time the survey was made was about 1,550 second-feet. The low-water channel of the Green River at this point had been forced against the left bank and had a width of 150 feet, compared to about 600 feet immediately above the bar. This condition caused a slight riffle having a drop of about 0.3 foot. The depths in the channel across the riffle (shown in photograph 32) were extremely shallow; above and below the riffle the channel depths run from 3 to 5 feet, tapering off to zero at the bars. The only permanent feature is a sandstone outcrop on the right bank at, and for some distance below, the mouth of the San Rafael. The right bank above and below the outcrop was dirt and was being cut. The left bank was dirt with some gravel and was also being cut. I took Photograph 33 looking upstream at the left bank to show the manner in which the dirt banks crack and slough into the river.

The San Rafael bar as a whole is probably more changeable in size and shape than any of the bars previously discussed. The bar lies on the outside of the bend and occupies what would ordinarily be the main channel. There is therefore a constant struggle between the forces that form the bar and the forces of the main stream. Any sustained floods in the Green will naturally submerge and obliterate the bar at least in part. Between such floods a part of the material carried by the San Rafael will be deposited and create conditions similar to those which existed October 6, 1928. Between these two extremes almost any condition is likely to prevail. A definite idea of the amount of change is obtained by a comparison of the Army Engineers' survey of November 30, 1909, photograph 33–A taken March 2, 1928, and my survey of October 6, 1928. (See pl. 29.)

On November 20, 1909, when the flow at Green-river was about 2,600 second-feet, the main channel followed the right bank and had an average depth of 3 feet and an average width of 200 feet. The bar was in the form of an island having a maximum width of 500 feet and a maximum length of 2,250 feet. The central portion of the island was high enough to support a growth of willows. The left-hand channel was so shallow it would not pass a skiff. A photograph taken March 2, 1928, by A. B. Purton, district engineer, U. S. Geological Survey (photograph 33–A) shows the bar broken into four parts with the channel meandering between. The discharge at that time was 3,300 second-feet.

Channel Conditions Between the Outstanding Bars (Railroad Bridge to San Rafael River)

Railroad bridge to Browns riffle (mile 117.3 to mile 117.1).—October 1, 1928, discharge at Green River 1,930 second-feet. Depths [5] in the course followed by the boat varied from 2 to 5 feet. It may be assumed, unless otherwise stated that the row boat was being kept as nearly as possible in the deepest part of the channel so that soundings made from the boat represent about the maximum depth in the cross section. Banks on both sides earth and being cut. Piles have been driven to protect the intake to the City waterworks just below the railroad bridge.

Browns Riffle to Mohre Riffle (mile 117.1 to mile 116.5). October 1, 1928. Mud bar along right bank just below Browns Riffle on which boat stuck

[5] All soundings were made with a ½-inch metal rod graduated to feet and tenths with a plate on the bottom to keep end and from sinking into bed and thus over-registering.

getting to shore. Bottom firm sand and in places quicksand. Soundings showed depths ranging from 2 to 4 feet. Banks on both sides earth and in general I observed that they were being cut. Drift and debris was prevalent along the banks.

Mohre Riffle to Twomile Riffle (mile 116.5 to mile 115.5).—October 1, 1928. Just below Mohre Riffle is a long diagonal crossing bar over which the depth in most places was less than 2 feet. Another similar bar extends for 2,000 feet across the channel just above the head of Twomile Riffle. Depth in the course followed by the rowboat, except over these two bars, was found to be about 3 feet. Over the bars depths ranged from one-half to two and one-half feet. Banks dirt; and they were observed being cut, cracking, and slumping into the river. Drift was prevalent along the edges of channel and collected on surface of bars.

Twomile Riffle to Butterfly Riffle (mile 115.5 to mile 114.5).—October 2, 1928, discharge at Green River 1,680 second-feet. Depths averaged 3 feet. No defined crossing bars. Soundings which were made indicated generally a gravel bed.

Butterfly Riffle to Auger Riffle (mile 114.5 to mile 112.5).—October 2, 1928. The following depths were indicated by the following soundings in feet, made about every 200 or 300 feet between mile 113 and mile 114: 4, 3, 3, 4, 4, 5, 5, 4, 4, 3, 2, 3, 3, 4, 4, 5, 5, 6, 6, 6. In general soundings of less than 3 feet indicated that the boat was not in the deepest part of the cross section. There seemed to be less bank cutting in this stretch than above.

Auger Riffle to Farrer Riffle (mile 112.5 to mile 111).—October 3, 1928, discharge at Green River 1,590 second-feet. Soundings in feet made about

every 250 feet. (S indicates sandy bottom, G gravelly bottom): S 4, S 4½, S 5, S 5, S 4, S 3.5, S 4, S 4, S 3½, S 4, S 4, S 4½, S 5, S 5, S 3½, S 3, S 3½, S 3, S 3, S 3, S 3, S 3, S 3, S 3, G 3, G 2½, G 2½, G 2½, G 1½ (head of Farrer Riffle). It may be seen that the depths in most places were over 3 feet. No outstanding crossing bars were observed in this stretch. Banks dirt and in places were being cut.

Farrer Riffle to Cable Riffle (mile 110 to mile 109.9).—October 3, 1928. In this stretch considerable of the bed of the river seemed to be mud and has been indicated by M in the following soundings: G 1½, G 2, S 4, G 3½, G 3½, G 3, G 3½, G 3½, M 3, M 3, G 4, G 3, G 4, G 4, G 5, G 4, G 7, G 5, G 5, G 5, G 3½, G 4, G 4.

Cable Riffle to crossing bar (mile 109.9 to mile 109).—October 3, 1928. Soundings showed depths as follows: G 5, S 5, G 3, G 2½, S 3, G 2½, G 4, S 5, G 3½. No defined crossing bars. Bed of river largely gravel and should be fairly permanent. Banks were sloping and did not appear to be cutting appreciably.

Crossing bar to Halverson Riffle (mile 109 to mile 108.5).—October 4, discharge at Greenriver 1,550 second feet. Soundings showed depths G 3½, G 3, G 2½, G 2, G 3, G 4½, G 3, G 5, G 5½, S 3, S 2, S 1½ [6] (head of Halverson Riffle). Channel seemed fairly permanent down to the head of Halverson Riffle, where the channel seemed to be full of fine material deposited back of the coarse material forming

[6] Whenever the soundings were 2 feet or less it was generally not safe to attempt further soundings as we had to be ready to get out and hold the boat in case it ran aground or struck rocks.

the Halverson Bar. Right bank 10 to 12 feet high and was being cut appreciably. Left bank sloping and more permanent.

Halverson Riffle to Bar at mile 106.7 (mile 108.5 to 106.7).—October 4, 1928.

Soundings showed depth as follows: S 2½, S 6, S 5, S 5½, S 4, S 3, S 4. No outstanding crossing bars in this stretch.

Bar at mile 106.7 to Gimlet Riffle (mile 106.7 to mile 106).—October 4, 1928. Depths as follows: S 2, S 2, S 5, S 4, S 4, S 5, S 5, S 5, M 3½, S 3, S 5, S 4, S 4, S 4, S 5, S 4, S 5, G 4, G 4.

Gimlet Riffle to Sunaba Riffle (mile 106 to mile 104).—October 5, 1928, discharge at Green River, 1,540 second-feet. Depths as follows: (R=rock) [7] G 4, G 3, G 3, G 3, G 2, G 2½, G 2½, G 3, G 3, S 4, S 3½ G 3, R 3, R 2½, R 3, R 3, G 4, R 5, R 4. Many of these soundings indicated a rock bottom. In this section shale outcrops may form the channel and if so conditions will of course be stable. There were some side [8] bars along the channel the edges of which are cutting.

Sunaba Riffle to Second Anvil Riffle (mile 104 to mile 101.5).—October 5, 1928.

Soundings showed depths as follows: R 2, R 2½, R 2½, R 2½, R 3, R 2, R 3, S 2, S 3, S 5, S 5, G 4, G 4, S 4, S 4, G 3, S 4, S 4, G 3, G 3, G 3, S 4, S 4, S 4, G 3, G 3, G 3, S 4, S 4, S 4, S 2½, S 3, S 3, S 3½, S 3½, S 4, S 4, S 5, G 6, G 5, G 5, G 6, G 7, S 4, S 4, S 3.5. In this stretch Salt Wash Canyon Centers

[7] In a muddy stream like the Green, it is difficult to determine from isolated soundings whether the bed is solid rock or made up of individual rocks.

[8] Exposed bars attached to the bank.

from the left (at mile 103.3). There is a small bar at the mouth through which the current has cut a channel 175 feet wide and well over 2 feet deep. Half a mile below the mouth of the wash is another crossing bar. It is probable that these crossing bars are largely a result of material brought in by Salt Wash.

Second Anvil Riffle to First Anvil Riffle (mile 101.5 to mile 100).—October 5, 1928. There were no outstanding crossing bars in this stretch, and depths were fully 3 feet as far as the head of First Anvil Riffle, where depths of less than 2 feet were encountered. Most of the soundings were in sand.

First Anvil Riffle to San Rafael Riffle (mile 100 to mile 94.9).—October 6, 1928, discharge at Green River 1,550 second-feet.

River is wider in this stretch than above. Velocities low. Depths ranged from 1½ to over 5 feet. Although the river was wider no special difficulty was encountered in locating a channel in which there was enough water to float the rowboat, the velocities being sufficient to show the location of bar lines. Between mile 96 and mile 97, there was a large island bar at which channel depths were shallow. (See photographs 31 and 115.) Banks were observed as being cut more or less throughout.

Channel Conditions in Green River

Green River from San Rafael River to mouth (mile 94.9 to 0).—October 9–17, 1928, flow varied from 1,640 to 15,400 second-feet.

About 3 miles below the mouth of the San Rafael River the rock walls close in, and thence to the mouth the Green River flows in an almost unbroken canyon, the upper part of which was named Labyrinth Canyon

by Powell on account of its windings and the lower part Stillwater Canyon. In this stretch are exposed the following rock formations, listed in downstream order with brief description.[9]

NOTES ON GEOLOGY

Carmel formation.—A red to reddish-brown muddy sandstone. In places it weathers shaly and in others into rounded forms.

Navajo sandstone.—A medium fine-grained sandstone, yellowish buff to buffy brown, tarnishing brown or black. Weathers, in places, into picturesque rounded dome-like forms, huge "cathedrals" or "mosques."

Todilto formation.—Largely sandstone, weathering into benches that form the platform lying above the Wingate.

Wingate sandstone.—The most spectacular topographic feature of the whole region. For miles it rises as a reddish-brown vertical cliff, 300 feet or more in height, walling in the tributaries of the Green as well as the Green itself, or forming an impassable barrier between the lower valleys and the relatively flat plateaus above.

Chinle formation.—Sandstone, mudstone and shale; extremely variable as to color and weathering.

Shinaromo conglomerate.—Topographically a vertical ledge, unscalable except in a few places.

Moenkopi formation.—Generally reddish-brown sandstone and shale. Topographically a steep slope broken by vertical sandstone ledges.

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[9] From an unpublished report in the files of the U. S. Geological Survey on the stratigraphy and structure of the region between the Green and Colorado Rivers, San Juan and southern Grand counties, by Edwin T. McKnight.

White rim sandstone.—A white sandstone that crops out as a vertical cliff, unscalable except at a few scattered points.

Cutler formation.—Dominantly red sandstone, shale and limestone. Topographically a cliff, which generally can be scaled.

Rico formation.—Alternate beds of sandstone, limestone, and shale.

Hermosa formation.—Topographically a steep wall; blue, green, and gray limestone.

In the 94.9-mile stretch the river has a total fall of about 111 feet, or at the rate of 1.17 feet to the mile, ranging from 1.9 feet for the first 7 miles below the San Rafael to 0.8 foot in the 11-mile stretch between Mineral Canyon and Hell Roaring Canyon (mile 42.8 to mile 53.8). There are in the slope no pronounced breaks which are distinguishable to the eye, and at the time of my investigation the river flowed in a stretch unbroken by the slightest riffle except such as were caused by air movement. In this respect it was entirely different from the stretch above the San Rafael which as already described contains distinct riffles.

Although the river is in a canyon throughout, the channel does not necessarily flow continuously against rock walls or talus slopes. Throughout a very large part of its course the river is meadering between its rock walls, and where the flow channel does not abut against rock walls or talus slopes there are bars or benches, which have been developed generally by the river but in certain places by side drainage. These bars are a predominant feature and were carefully considered. Four typical ones were surveyed, at miles 84.5, 80.5, 72.2, and 23–24. The conditions observed at these bars are set forth below:

Bar at mile 84.5.—The survey of the side bar at mile 84.5 (pl. 30) shows typical meandering of the channel between the rock walls and also the side bars lying between the low-water channel and the main walls of the canyon. This survey was made by the writer on October 11, 1928, when the mean discharge at Greenriver, Utah, was 1,830 second-feet. Photographs 42 and 121 illustrate the character of the material making up the bars. Extending out from the rock walls on each side, except where subject to the full thrust of the current, are the typical high willow-covered bars and benches, the stream edges of which were being cut by the current and slumping into the river. Lying between the high bars and the river are the low bars of sand or mud (depending upon the stage of the river), generally from 1 to 5 feet above the water. The surfaces of the bars were, as a rule, not smooth but scored with high-water channels (see pl. 33–A). The edges of the bars may have a gradual slope against which the water gently ripples, or may present a vertical face from 1 to 3 feet high which is continually being cut and slumping into the river. The falling material causes eddies and increased currents, which rapidly dissolve the material and wash it away to be deposited, I believe, in the broad straight stretches below the bends where the velocities diminish, thereby building up the crossing bars. The channel swings from rock wall to rock wall. It is evident that a small increase in height of the water will submerge the lower bars and then the water will occupy the full width between the higher bars and cause increased cutting of the edges of the upper bars. Under such conditions of flow the side bars form submerged obstructions which, I observed, made it difficult for Blake to find a con-

tinuous channel having sufficient depth to float the boat. Here again it should be noticed that increase in flow does not necessarily mean that a boatman will have less difficulty in locating a channel.

Bar at mile 80.5.—Between mile 80 and mile 81 the Green River makes a decided bend from left to right. On the inside (right bank) there is a large bar so typical of the bars along the river that a special plane-table survey (see pl. 31 for plan and pl. 33–A for cross section) was made on October 11 and 12, 1928. The flow was changing rapidly, being 1,830 second-feet at Greenriver, Utah, on October 11 and 12,000 second-feet on October 12. The increase in stage at the bar amounted to about 5 feet as compared to 3½ feet increase at Greenriver. Photographs 122, 123, 124, and 125 add details not shown by the survey. The left or outside bank is a sheer rock wall against which the main channel flows. Extending between 250 and 300 feet out from the right rock wall and talus was a willow-covered bench or bar lying 12 to 15 feet above the river. These higher bars are invariably covered with so dense a growth of willows that it is almost impossible to get through them without chopping a path. The outside edge of this bar was almost vertical. Running out from this high bar was an intermediate bar having a maximum width of 600 feet. This bar was 4 to 6 feet above the water and the surface is somewhat cut up with channels formed during high water. The upstream edge of the bar slopes to the river. The downstream edge was generally vertical and was continually being cut and slumping into the river. Between this intermediate bar and the main channel were a series of bars 200 to 300 feet wide, which were practically level with the water surface. The effect of these partly submerged bars in

catching and holding drift during flood stages is best shown by photograph 127, showing the accumulation of drift during the morning of October 12, when the flow was probably more than 10,000 second-feet. The relation of the surface of the bars to the ordinary water surface is best shown in the cross section on Plate 33–A. Almost invariably next to the outer bank at this and other similar bars on the inside of bends depths of 3 feet and upwards were noted. At low stage the current follows the bends without creating decided eddies. As the stage and the velocity increase, eddies are formed, disturbing channel conditions.

Bar at mile 72.2.—Between miles 71.8 and 72.5 the Green River makes a decided bend from left to right. At this point there is the usual inside bar. A survey (see pl. 32 and photographs 49 and 127) was made on October 12. Mean discharge at Green River, [Greenriver, Utah] 12,000 second-feet. The characteristics of this bar are so similar to those at mile 80.5 and so typical of the bars at the inside of bends that special comment seems unnecessary.

Tuxedo Bar, mile 23–24.—Between mile 23 and mile 24 on the left bank of the Green River is an extensive bar, one of the largest along the lower stretch of the river. A survey of this bar was made by the writer on October 16, 1928. (See pl. 33 for plan and pl. 33–A for cross section.) Mean discharge, Green River, 5,150 second-feet. In this stretch the Green River makes a long bend from right to left, and the bar is on the inside or left bank. Except that the bar is larger, its characteristics were not materially different from those of other bars upstream and downstream. Next to the left rock wall was a high willow-covered bar or bench. This bench had a length of

nearly a mile and is subject to cutting when the lower bar is overflowed. The lower bar had a maximum width of 850 feet and was nearly a mile long. Its sandy surface was from 3 to 9 feet above the water and very irregular, owing not only to scour in overflow channels but also to wind action. Photograph 62 shows a sand dune formed by the wind at the lower end of the bar and photograph 61 a hole apparently caused by eddies and swirls during flood stages. The cross section (pl. 33–A) shows the irregular surface and a high-water channel next to the left bank. Two other cross sections were taken which showed similar characteristics. It is entirely possible that the left channel may deepen and the center part of the bar be built up into an island. Depths in the channel next to the right bank had a maximum depth of 10 feet.

CHANNEL DEPTHS AND SOUNDINGS—GREEN RIVER FROM SAN RAFAEL RIVER TO MOUTH

On Plates 38 to 43 the bars exposed at the time of my investigation have been indicated in red and the outstanding crossing bars in dash red lines. Literally hundreds of soundings were made which showed depths ranging from practically 0 to over 10 feet. Fully 95 per cent of the soundings were made when the boat was supposed to be in the deepest part of the channel and the greater majority of these showed 3-foot depths. The depths may range from 1 foot to 7 feet in very short distances. In general, around every bend the depths were greater than in straight stretches and the thread of maximum depth could be easily identified. In all straight stretches the position of line of maximum depths was indefinite and could be located only by the cut and try method.

Many crossing bars were barely awash and can be generally avoided. Many others were from 6 inches to 1½ feet below the water surface and not be evident until they are struck. In so far as progress with the rowboat was concerned, the oars were found the most satisfactory measuring device, for whenever they hit bottom in ordinary rowing it was time to begin to look for deeper water which frequently could not be found.

Bars—General.—As indicated in part by the large-scale surveys the principal permanent features of the Green River are its rock walls. Those walls, however, are rarely closer than 1,500 to 2,000 feet, therefore, the river has considerable freedom of action and meanders in an alluvial channel, cutting the banks where they are exposed to the thrust of the current and building up bars where the velocities diminish. The river is constantly shifting, sorting, and redistributing the enormous volumes of silt and sediment brought into it in suspension and bed load. Although the greater part of the material probably comes from areas above and including the San Rafael River, the extensive surface of the plateau region adjacent to the rivers is cut with gullies and washes which, following cloudbursts, debauch material into the canyon sections. My surveys and investigations indicate that frequently half of the flood channel and three-quarters of the cross sections between the rock walls are occupied by sand bars and willow-covered bars or benches.

The unexposed bed of the Green River between the San Rafael River and its mouth and the Colorado River, from the mouth of the Green River to Moab, was found to be sand of various degrees of fineness. As is to be expected in a channel composed of fine

material the surface of the bed, although most irregular, had characteristics which appear common to channels in unstable material. Within the limits of the rock walls we therefore have a river flowing in a channel unstable as to bed and banks but at the same time having certain prominent features such as side bars and crossing bars which are common to all rivers flowing in alluvial material and their formation undoubtedly follows certain laws of nature which are not thoroughly understood at the present time. The crossing bars are probably the most troublesome as far as depth and permanency of channel are concerned. Since these crossing bars are for the most part submerged it is practically impossible to map them and still more difficult to definitely explain and analyze the reasons for their existence. Although all rivers naturally seek meandering courses with resultant swifter current and well defined channels next to the concave shore, if they are to arrive finally at a destination, reverse curves are necessary. Coincident with all such reversals on the Green and Colorado in the stretches under consideration with few exceptions are crossing bars, and it is apparent that the reversal of the current from one bank to the other is the primary cause of crossing bars. These bars extend diagonally across the channel and average in length from 1,000 feet to possibly more than 3,000 feet.

It is evident that when the river is at flood stage the channel is full from bank to bank. Velocities in the cross sections are, however, known to vary within wide limits, even where the cross section is regular and the channel straight. Each change in the cross section or direction of the channel is attended by a redistribution of velocities in the cross section and a change in the direction of the thread of maximum

velocities. These changes in velocity give rise to the formation of whirlpools, eddies and backwater, with the resultant decrease in the velocity and a partial or complete deposition of load carried in suspension or as bed load. When the direction of current is changed as a result of a reversal of curvature of the channel, there is change in the distribution of velocities. The thread of maximum velocity which as a result of centrifugal force follows the concave bank is diverted diagonally across the channel and downstream. The reduction in the velocities parallel to the thread of the current is apparently sufficient to cause a complete or partial deposition of load resulting in the building up of long diagonal bars, paralleling approximately the thread of the velocity. The assumption that these crossing bars, more especially those composed of the finer materials, are continually changing their size, shape, and location is logical when it is considered that not only does the position of the thread of the current change appreciably with each change in flow but also during low stages when changes in flow are minor the material cut from the lower side bars drifts along to be deposited in the wider cross sections at the crossing bars.

The bars which form along the inside of the bends, the general character of which has been shown by my large-scale surveys, seem to fall in three general types. *First*, the bars that are partially awash during low-water periods; *Second*, extensive sand bars having an average height of 4 to 6 feet above the water; and *Third*, the willow-covered bars and benches ranging 12 to 15 feet in height.

The bars that are practically awash at the lower stages are the result of the lowering of the velocity in the cross section next to the inside of the bends

resulting from eddies and backwater. The material making up these bars is so fine that their surfaces can be seen to be in constant motion, the particles shifting and moving around with the smallest disturbance in the water. The material in these bars is so fine that the pressure of the little finger was frequently sufficient to sink out of sight the 8-foot sounding rod which was one-half inch in diameter. It is clearly evident that these portions of the river bed are, accurately speaking, in a constant state of change caused by all changes in velocity due either to change in stage or ripples and waves caused by wind.

The sand bars that lie between 4 and 6 feet above the water are apparently formed during ordinary floods. Between such floods they are subject to minor changes as a result of the gradual washing away of their edges where exposed to the current, the apparent gradually building along their downstream slopes, and surface changes resulting from wind movement. It is my conclusion that many of the changes occurring at the crossing bars during low and medium stages are a result of the gradual wearing away of these low bars. The formation of the higher willow-covered bars or benches is not so easily analyzed. These bars or benches, which extend probably for one-half the distance through the canyon, form the flood channel limits for all except the most extraordinary floods. It is evident that they are composed of sediment brought into the canyon section, and their height above the normal water surface indicates that such deposits could have been laid down only during the most extreme floods. All ordinary floods cut these banks rather than add to their height. It seems evident, therefore, that these enormous flats or, in reality, bars, many of which contain

from 1 to 5 million cubic yards, are the result of extreme floods and that except for side cutting and surface erosion they are fairly permanent for long periods of time. Their presence may also be explained as a result of a change in flow conditions resulting from changes in climate. In the canyon sections we therefore have three degrees of permanency:

First, the bed of the low-flow channel of which the crossing bars are a part which, to speak accurately, is constantly shifting as the result of a rearrangement of the finer materials of which it is made up and of the constant addition of material brought into the section both in suspension and as bed load;

Second, the sand bars which lie from 1 to 5 feet above the water at low flow stages and which are fairly permanent for periods between ordinary high-water stages, such minor changes as take place consisting of the gradual cutting and sloughing off along the edges and changes in surface configuration due to wind;

Third, the large willow-covered flats which are permanent for long periods between exceptionally high floods except for spasmodic cutting along their edges during ordinary flood periods and by surface erosion.

It is roughly estimated that the amount of canyon fill in these bars, including only that part lying above the bed of the river, ranges from about 1,200 acre-feet to the mile in stretches where small bars predominate to 3,000 acre-feet to the mile in stretches where bars similar to the Tuxedo Bar, mile 23, predominate. An estimate of 1,000 acre-feet to the mile for the 95-mile stretch would be conservative, or a total of 95,000 acre-feet which does not include an undetermined amount which may be over 100 feet and overlying below the river bed. This amount represents very roughly the canyon fill between the San

Rafael River and the mouth of the Green River, which is now subject to change. Enormous amounts of sediment which may easily exceed 25,000,000 cubic yards per year are being carried into the canyon as the result of erosion in the whole area tributary to the Green River. Whether the Green River is now transporting to its mouth all the material brought in is a matter of speculation. It is doubtful if information is available that would demonstrate conclusively whether in the long run the channel is aggrading or degrading. We do know, however, without the shadow of doubt that the Green River, through the greater part of its course between Green River and the mouth of the San Rafael River and all its course below the mouth of the San Rafael River, is flowing in a channel of unconsolidated material which, within the limits of the rock walls, is unstable.

Colorado River

HEAD OF CATARACT CANYON TO MOUTH OF GREEN RIVER

In the stretch of 4.2 miles on the Colorado River between the head of the first cataract and the mouth of the Green we have the combined flow of the Green and Colorado Rivers, which on October 18, 1928, totaled 10,180 second-feet for the combined flow at Green river and Cisco. The fall is somewhat greater than in either the Green or the Colorado River above the junction averaging 2.1 feet to the mile down to the head of the first cataract, and the velocity is appreciably higher. The flow channel almost immediately takes on a different aspect, the banks being strewn with boulders, with many in the channel. Our boats went downstream 2½ miles, but it did not seem safe to venture farther on account of the possi-

bility of hitting submerged rocks. Photograph 142 shows the character of the channel at the lower limit reached with the boats. Photograph 144 shows one of the bars 3½ miles below the junction. Photograph 145 shows the second cataract rapid 4½ miles downstream. Although the fall is only 5 feet at this particular cataract, it is perfectly evident that these cataracts form an impassable barrier to all but the most thoroughly equipped parties, especially when it is noted that there are 49 of them in the 55-mile stretch below the mouth of the Green.

MOUTH OF GREEN RIVER TO MOAB (MILE 0 TO MILE 65.5)

October 18 to October 22, 1928, flow at Cisco varied from 3,770 to 4,520 second-feet.

In the 65½ miles between the mouth of the Green River and Moab bridge the Colorado River has an average fall of 1.4 feet to the mile. Except at one locality (The Slide, mile 1.8) there were no apparent changes in the slope, and the channel characteristics are so similar throughout that there seems to be no reason why the entire stretch should not be considered under one heading. I made special surveys at The Slide (mile 1.8) and the bar at mile 15.7.

The Slide (mile 1.8).—The Slide, on the Colorado River 1.8 miles above the mouth of the Green River, was surveyed on October 18, 1928, mean flow 4,520 second-feet at Cisco. (See pl. 34). Photographs 66 and 147 are views looking upstream from the left bank and 67 a view looking downstream from the right bank. The Slide consists of extremely large boulders as much as 20 to 25 feet in diameter, which have apparently slid into the channel forming an obstruction about 400 feet wide forcing the water against the left rock wall into a channel barely 100

feet wide. A head of about 6 inches is created, with resultant velocities of 4 to 6 miles an hour. The channel itself is apparently free from any rocks near the surface. Neither boat had any difficulty in going upstream through the channel, although just above The Slide on the left side the small boat hit a small sand bar. On a rise of 12 or 14 feet a part of the water will flow in a channel next to the right bank and part of The Slide will be in the form of an island. Roughly, The Slide contains 80,000 cubic yards of rock above the water surface.

On November 11, 1909, a survey of The Slide was made by the Army Engineer Corps. According to a note accompanying the resulting map the flow was estimated to be about 3,500 second-feet. A comparison of conditions at The Slide then and now is shown by Plate 35. It is evident that there has been little if any change in conditions and unless additional material should slip off the rock walls there will probably be no change in the near future. This is therefore one of the few cross sections that can be classified as stable. At no other locality between the Green River and Moab is there an accumulation similar to The Slide. In fact, I have seen no reference to one anywhere along either the Colorado or the Green River, although such a slide would be expected to occur frequently along these rivers flowing largely between massive rock walls.

Bar at mile 15.7.—Between mile 16 and mile 17 the Colorado River makes more than a right angle bend from right to left. Conditions at the bend seemed sufficiently unusual to warrant a plane-table survey which was made October 20, 1928. (See pl. 36.) The discharge at Cisco, Colo., on this day was 4,090 second-feet. Photographs 71 and 151 are

views looking downstream from the right bank. Bar conditions on the left bank were typical of the bars forming on the inside of bends. In this particular locality there was a willow-covered bar at a height of about 12 feet above the water extending out from the rock wall between 400 and 500 feet. The stream edge of the bar is subject to being cut at higher flows and will gradually slump into the river. Extending into the stream was a low sand bar with a maximum height of possibly 1 to 2 feet above the water. At the time of the survey this bar had a maximum width of 450 feet and was 1,250 feet long. It is evident that any appreciable rise in the stage will submerge this bar and cut against the higher bar. Along the right bank the channel abuts partly against a rocky talus slope. At the turn, however, the current strikes a dirt bank about 12 feet high, formed at the mouth of a small wash that empties into the Colorado River at this point. The force of the current has cut the bend back more than 100 feet and created a decided whirlpool. Nearly all of the flow channel was occupied by this whirlpool and unless care had been taken we might have had considerable trouble with our small boat. Each flood in the wash probably tends to build up the right bank, which is continually being broken down by the current. The river survey made in 1912 shows very nearly the same bar conditions at this point, but the right bank at the bend does not indicate excessive cutting. The Army Engineers' survey was apparently devoted largely to riffles and no particular attention was given to side bars.

At all the bends between Green River and Moab the outside of the channel has to a very large extent adjoined a rock wall or talus slope, which has tended

to turn the flow without creating excessive eddies or whirlpools. At this locality there is a break in the continuity of the outside channel with consequent disturbances.

CHANNEL CONDITIONS, COLORADO RIVER FROM THE MOUTH OF THE GREEN TO MOAB

Except at The Slide and possibly one or two isolated localities, the Colorado River between Moab and the mouth of the Green River flows in a canyon fill of unconsolidated shifting sand and silt. The limits of horizontal shift are fixed by the adjacent rock walls and talus slopes, but between these limits the river meanders similarly to the Green. With the exception of the bar at mile 15.7 the exposed bars were so similar in character to the bars that were surveyed along the Green that it seemed unnecessary to make detailed surveys of them. Any one of the bars shown on Plates 30 to 33 could, with a few changes in general dimensions, be used to illustrate bars along the Colorado. The impression was gained that possibly the higher willow-covered bars along the Colorado were less extensive than those on the Green, but I have no definite information on this point. Similarly the impression was gained that there may be more crossing bars along the Colorado, and I have some evidence to support this impression.

Roughly there are about 2.7 acres of low exposed sand bars to the mile along the Colorado compared to about 1.4 acres to the mile along the Green below the San Rafael. This ratio would probably hold true for the submerged crossing bars. In view of the fact that we were using power-propelled boats going up the Colorado compared to rowboats drifting down the Green, the crossing bars were more in evidence and caused more trouble. All side and crossing bars

are noted with appropriate symbols on the accompanying river-survey maps, Plates 44, 45, and 46. Outstanding bars were observed at mile 3.5, 4, 4.9, 7.8, 10, 11.8, 14, 16.5, 19.5, 21, 21.5, 22, 28, 29.5, 31.8, 33.8, 36.5, 39, 40, 43, 46.5, 48.5, 49.5, 50, 50.6, 53.9, 54.2, 54.4, 55.5, 56, 57, 59, 61, 62, 62.8, 64.4, and 64.8. Most of these bars are in straight stretches of the river and there is every reason to believe that under the same flow conditions they maintain about their same relative position. However, long periods of uniform flow are unusual and with variable flow the unstable condition of crossing bars previously discussed will prevail. Without exception the channel depths across these bars were shallow, though generally a depth of between 1 and 2 feet could be found, sufficient to enable the boats to plow through. The most common channel depths at the bends and between the bars ranged from 3 to 5 feet.

Roughly speaking, the drainage area tributary to the Colorado River below Moab is twice as large as the area contributing to the Green below the mouth of the San Rafael. Courthouse Wash and Mill Creek, discharging into the Colorado River in the vicinity of Moab, and Kane Spring Wash, Lockhart Creek, Indian Creek, Salt Creek, and Red Lake Canyon coming in below Moab, all drain extensive areas subject to erosion, and the load carried by these tributaries during floods may have produced a considerable amount of the canyon fill, because there is indication that during such periods they may fill channels 100 feet wide and 10 feet or more deep with a velocity sufficient to roll and otherwise move large boulders. Roughly speaking, about 40,000,000 cubic yards of sediment may pass Cisco during a year.

At mile 35.4 and mile 48.4 submerged rocks were reported to occur in the channel on which several boats had hit. At other isolated places rocks had fallen into the channel from the cliffs, but these, as well as the drift, were generally next to the bank and easily avoided.

Considering the flow channel as a whole probably 25 per cent follows the outside of bends and is generally well defined; the remainder occupies straight stretches and is not so well defined.

COLORADO RIVER BETWEEN MOAB AND CASTLE CREEK

For the first 2 miles above Moab channel conditions are comparable with those in the section below. At mile 68, at the mouth of Sheep Creek, and again at Nigger Bill Creek coarse material brought into the channel has formed decided rapids, which, with rocks in the channel, set an upstream limit for the type of boat used below Moab. From this point to Castle Creek rapids are numerous and the channel is strewn with boulders. Photographs 171 and 172 show conditions at the mouth of Salt Wash (mile 76.3), at the mouth of Castle Creek.

COLORADO RIVER ABOVE MOAB, BETWEEN MILE 70.9 AND MILE 72

In order to show the general characteristics of the Colorado River above Moab in more detail than was possible on the small-scale river-survey map made in 1912, a plane-table survey of a stretch between mile 70.9 and mile 72 I made October 23, 1928, on a scale of 1 inch to 500 feet. (See pl. 37.) Flow at Cisco on October 23, 1928, 3,650 second-feet. It is obvious from an examination of my survey that the Colorado River has changed from a comparatively wide slow-

flowing river with sandy bottom meandering between rock walls to one having more of the characteristics of a steep mountain stream. The channel is narrow averaging only about 200 feet or less. Small rapids are numerous, there being three in a distance of 3,000 feet, and the channel, especially at the riffle, is strewn with rocks. The fall averages about 5 feet to the mile, or several times the average slope downstream from Moab. The side channels are steep, and large talus cones have been built up at their mouths, contracting the channel and forming rapids. The velocity is apparently sufficient to transport all the finer material, consequently the bed of the channel is made up of coarse gravel and rocks. It is probable that the conditions are fairly stable. Side streams will no doubt continue to dump material into the channel which will tend to fill up with the coarser part of such material.

SILT IN SUSPENSION—GREEN AND COLORADO RIVERS.

During 1914 and 1915 the Bureau of Reclamation made determination of the amount of silt carried in suspension by both the Green and Colorado Rivers. The method followed consisted in taking about a quart sample of water every few days and determining the percentage of silt which it contained. The results of these experiments are summarized in the following table from Technical Bulletin 67, U. S. Department of Agriculture: "Silt in Colorado River in relation to irrigation by Samuel Fortier and Harry F. Blaney, February, 1928." I have added columns 2 and 5 to show the mean monthly flow and the approximate equivalent of suspended matter of dry soil.

Silt in suspension

COLORADO RIVER NEAR CISCO, UTAH

Month	Mean flow	Proportion of silt by weight	Quantity of silt carried	Approximate equivalent of suspended matter in terms of dry soil	
				On basis 1 cu. ft. = 33 lbs.[1] 1 cu. yd. = 0.445 ton	On basis 1 cu. ft. = 86 lbs.[2] 1 cu. yd. = 1.16 tons
1914	*Sec.-Ft.*	*Mean Per cent*	*Tons*	*Cubic yds.*	*Cubic yds.*
Aug.	8,120	[illegible]			
Sept.	4,460	.347			
Oct.	6,080	.596			
Nov.	3,520	.033	57,000	128,000	49,000
Dec.	2,350	.032	63,000	142,000	54,000
1915					
Jan.	2,120	.032	57,000	128,000	49,000
Feb.	2,540	.067	128,000	288,000	110,000
Mar.	2,870	.062	149,000	333,000	128,000
Apr.	9,710	.450	3,540,000	7,993,000	3,050,000
May	18,300	.180	2,744,000	6,180,000	2,370,000
June	26,000	.090	1,957,000	4,293,000	1,640,000
July	10,000	.057	477,000	1,070,000	412,000
				20,489,000	7,862,000

GREEN RIVER NEAR GREENRIVER, UTAH

1914					
Aug.	4,830	0.043	173,800	391,000	150,000
Sept.	2,630	.132	280,100	634,000	242,000
Oct.	1,960	.380	1,256,000	2,820,000	1,080,000
Nov.	2,720	.107	256,000	580,000	204,000
Dec.	1,530	.012	15,000	34,000	13,000
1915					
Jan.	1,260	0.05	70,000	157,000	60,000
Feb.	1,770	.050	40,000	90,000	34,000
Mar.	3,020	.080	225,000	506,000	194,000
Apr.	7,440	.217	1,309,000	2,940,000	1,130,000
May	11,000	.190	1,747,000	3,920,000	1,510,000
June	15,900	.148	2,373,000	5,330,000	2,050,000
July	9,160	.116	858,000	1,940,000	740,000
				18,992,000	7,183,000

[1] Sellew, Trans. Am. Soc. Civil Engineers 78, 1479 (1915).

[2] Rothery, Proc. Am. Soc. Civil Engineers 49, 677 (1923).

It will be noted that the amount of sediment in suspension alone may be between 7,185,000 and 18,692,000 cubic yards for a 12-month period in the Green River, and between 7,862,000 and 20,489,000 cubic yards in the Colorado River for a 9-month period. The Green River records do not include the sediment carried by Saleratus Wash, San Rafael River, and other washes between Green River, Utah, and Labyrinth Canyon, and the Colorado River records do not include sediment carried by Court House Wash, Mill Creek, Kane Spring Wash, Lockhart Canyon, and Indian Creek. Neither record includes bed load. It is roughly estimated that both of these rivers may each be transporting into these canyon sections between 10,000,000 and 30,000,000 cubic yards of sediment annually. Approximate as these figures may be, it is evident that a deposition of only a part of this load may partially clog the channel of a shallow river.

COMPLAINANT'S EXHIBIT 80

RAPIDS, RAPID WATER AND QUIET WATER COLORADO, GREEN AND SAN JUAN RIVERS

Compiled by W. G. Hoyt, Hydraulic Engineer, U. S. Geological Survey, May, 1929

The following tables show for comparative purposes the classification of the Colorado, Green and San Juan rivers with respect to:

(a) Rapids.
(b) Rapid water.
(c) Quiet water.

Exact definitions of these classifications are difficult. What I have in mind is about as follows:

(*a*) *Rapids.*—Obstruction in the flow by rock or boulder formation of such magnitude that a head of from 3 to 10 feet or over will be created in a relative short distance. The water flows over these obstructions with high velocities and the energy in the falling water is generally dissipated by standing waves several feet in height. So-called riffle or smaller rapids are caused generally by sand or gravel bar formations of such magnitude that a head of between 1 and 3 feet will be created in a distance of between 1,000 and 2,000 feet. The higher velocities due to the head together with the roughness of the bed and the shallowness of the water cause the surface of the water to break into waves 2 or 3 inches or more in height. As compared with the murmur of a riffle the roar of a rapid can be heard for thousands of feet.

The rapids form practically an unsurmountable barrier to upstream progress with any kind of a boat

and if any consideration is given to safety a downstream barrier to all except the strongest, best designed and most skillfully operated ones. The riffles on account of their shallowness and fairly high velocities can be passed upstream by boats having shallow depth and powered sufficiently to conteract the velocity. If care is used with shallow depth boats the riffles may not interfere greatly with downstream progress.

(*b*) *Rapid water.*—Stretches where the fall is such that the velocity of the water may be characterized as swift when compared with the quiet stretches, but not broken into waves such as are encountered in rapids. In terms of slope, stretches with slopes exceeding 2 feet to the mile have been in general classified as rapid water.

Quiet water.—Stretches where the fall is such that the velocity is low and the surface of the water smooth. In terms of slope stretches where the slope is generally less than about 2 feet to the mile have been in general classified as quiet water.

The profile of the river surveys have been the base for the classification supplemented by information from diaries, photographs and notes of the various parties. It should be borne in mind that with different rates of flow the character of the flow varies widely. The classification as here given is under low or medium flow conditions. As the flow increases the reaches herein classified as quiet water would take on the aspect of the rapid water stretches; the rapid water stretches take on the aspect of the riffles as far as velocities are concerned and many of the riffles would probably be classified as rapids.

The classification covers the Colorado River from Grand Junction, Colorado, to Lee's Ferry, the Green

River from the Wyoming-Utah line to the mouth and San Juan River from Chinle Creek to the mouth, a total distance of nearly 1,000 miles.

The tables show the mileage at the beginning and end of each stretch, the total fall and the fall per mile.

Briefly there are 216 rapids embracing 5.2 per cent of the total distance but having 30.8 per cent of the total fall, 143 stretches of rapid water covering 29.2 per cent of the total distance and having 40.1 per cent of the total fall and 125 quiet water covering 65.6 per cent of the total distance with only 29.1 per cent of the total fall.

Summary

RAPIDS

	Number	Total length	Average length	Total drop	Average drop	Average fall per mile
		Miles	*Miles*	*Feet*	*Feet*	*Feet*
Colorado:						
Lee's Ferry to Mouth of Green	49	9.12	0.186	302	6.2	33.0
Mouth of Green to Green Junction	25	16.59	.66	263	10.5	15.9
Green:						
Green River, Utah to mouth	[1]0	0	0	0	0	0
Wyoming-Utah line to Green River, Utah	125	20.72	.165	663	5.3	32.0
San Juan: Mouth to Chinle Creek	16	4.02	.252	117	7.3	29.2
Total	216	50.45	.233	1,345	6.2	26.7

RAPID WATER

	Number	Total length	Average length	Total drop	Average drop	Average fall per mile
		Miles	*Miles*	*Feet*	*Feet*	*Feet*
Colorado:						
Lees Ferry to mouth of Green	37	43.56	1.23	196	5.3	4.3
Mouth of Green to Greenriver Junction	22	66.58	3.03	311	14.1	4.67
Green: Wyoming-Utah line to Greenriver, Utah	67	40.51	.60	408	6.1	10.1
San Juan: Mouth to Chinle Creek	17	128.98	7.60	839	49.4	6.5
Total	143	281.63	1.97	1,754	12.3	6.22

[1] 13 riffles have been observed having total length 4.0 miles. Average length 0.27 mile total drop 37 feet, average drop 2.8 feet, average fall per mile 9.3 feet.

Summary—Continued

QUIET WATER

	Number	Total length	Average length	Total drop	Average drop	Average fall per mile
Colorado:		*Miles*	*Miles*	*Feet*	*Feet*	*Feet*
Lee's Ferry to mouth of Green	18	161.82	9.0	261	14.5	1.61
Mouth of Green to Greenriver Junction	20	89.93	4.5	102	5.1	1.13
Green:						
Greenriver, Utah, to mouth	1	117.30	117.3	170	170	1.45
Wyoming-Utah line to Greenriver, Utah	86	260.35	3.0	739	8.6	2.84
San Juan: Mouth to Chinle Creek	0	0	0	-------	0	0
Total	125	629.40	5.0	1,272	10.2	2.02

[1 Not exactly correct, as there are 15 riffles at which swift water occurs].

	Distance	Per cent of total	Fall	Per cent of total
Colorado River, Lee's Ferry to mouth of Green:	*Miles*		*Feet*	
Rapids	9.12	4.2	302	39.8
Rapid water	45.56	21.1	196	25.8
Quiet water	161.82	74.7	261	34.4
Total	216.50	100.0	759	100.0
Colorado River, mouth of Green to Gr. Junction:				
Rapids	16.59	9.6	263	38.9
Rapid water	66.58	37.9	311	46.0
Quiet water	89.93	52.5	102	15.1
Total	173.10	100.0	676	100.0
Green River, mouth to Greenriver, Utah:				
Rapids	0	0	0	0
Rapid water (see footnote 2, preceding table)	0	0	0	0
Quiet water (see footnote 2, preceding table)	117.30	100.0	170	100
Total	117.30	100.0	170	100
Green River, Greenriver, Utah, to Wyoming-Utah line:				
Rapids	20.72	6.4	663	36.6
Rapid water	40.51	12.6	408	22.5
Quiet water	260.35	81.0	739	40.9
Total	321.58	100.0	1,810	100.0
San Juan, mouth to Chinle Creek:				
Rapids	4.02	3.0	117	12.2
Rapid water	128.98	97.0	839	87.8
Quiet water	0	0	0	0
Total	133.0	100.0	956	100.0
Rivers as a whole:				
Rapids	50.45	5.2	1,345	30.8
Rapid water	281.63	29.2	1,754	40.1
Quiet water	629.40	65.6	1,272	29.1
Total	961.48	100.0	4,371	100.0

COLORADO RIVER, LEE'S FERRY TO MOUTH OF GREEN [RIVER]

The following two tables cover the stretch of Colorado River from Lee's Ferry to the mouth of Green River, a distance of 216.5 miles. Mileage corresponds to the mileage on the plans and profiles titled, "U. S. Geological Survey Plan and Profile, Colorado River, Lee's Ferry, Arizona to mouth of Green River, Utah (22 sheets, 16 plan and 6 profile) surveyed during September and October, 1921. The numbers given to the rapids are the same as those given them by the topographic engineers at the time of the river surveys and referred to by Freeman (Lewis R. Freeman, The Colorado River, page 362), as the official designation.

Colorado River, Lees Ferry to mouth of Green River

Character of flow	No. of rapid [1]	Beginning of stretch (miles above Lees Ferry)	Length of stretch (miles)	Elevation beginning of stretch	Fall, in feet	Fall, in feet per mile
Quiet water		0	67.52	3,120	110	1.63
Rapid water		67.62	1.20	3,230	5	4.17
Quiet water		68.72	31.45	3,235	49	1.52
Rapid water		100.17	13.98	3,284	51	3.64
Quiet water		114.15	5.30	3,335	10	1.89
Rapid water		119.45	1.05	3,345	5	4.76
Quiet water		120.50	27.42	3,350	50	1.82
Rapid water		147.92	2.13	3,400	15	7.04
Quiet water		150.05	8.05	3,415	15	1.86
Rapid water		158.10	2.95	3,430	10	3.39
Rapids	49	161.05	0.47	3,440	5	10.64
Quiet water		161.52	4.98	3,445	5	1.00
Rapid water		166.50	2.10	3,450	10	4.76
Quiet water		168.30	7.25	3,460	5	.69
Rapid water		175.85	5.15	3,465	14	2.72
Rapids	48	181.0	0.1	3,479	4	40.0
Quiet water		181.1	.3	3,483	(2)	(2)
Rapids	47	181.4	.1	3,483	4	40.0
Rapid water		181.5	.8	3,487	4	5.0
Rapids	46	182.3	.2	3,491	5	25.0
Rapid water		182.5	.15	3,496	1	6.66
Rapids	45	182.65	.15	3,497	17	113.0

[1] NOTE.—Number of rapids refer to numbers designated by the topographic engineer at time of survey.

[2] Negligible.

Colorado River, Lees Ferry to mouth of Green River—Continued

Character of flow	No. of rapid	Beginning of stretch (miles above Lees Ferry)	Length of stretch (miles)	Elevation beginning of stretch	Fall, in feet	Fall, in feet per mile
Quiet water		182.8	0.9	3,514	1	1.1
Rapids	44	183.7	.1	3,515	4	40.0
Rapid water		183.8	.15	3,519	1	6.7
Rapids	43	183.95	.15	3,520	7	46.6
Rapid water		184.1	5.7	3,527	14	2.5
Rapids	42	189.8	.2	3,541	4	20.0
Rapid water		190.0	.55	3,545	3	5.5
Rapids	41	190.55	.1	3,548	9	90.0
Quiet water		190.65	1.2	3,557	1	0.83
Rapids	40	191.85	.1	3,558	5	50.0
Quiet water		191.95	1.35	3,563	3	2.2
Rapids	39	193.3	.25	3,566	6	24.0
Quiet water		193.55	.5	3,572	1	2.0
Rapids	38	194.05	.1	3,573	3	30.0
Quiet water		194.15	.45	3,576	1	2.2
Rapids	37	194.6	.1	3,577	5	50.0
Rapid water		194.7	.25	3,582	1	4.0
Rapids	36	194.95	.30	3,583	12	40.0
Rapid water		195.25	.15	3,595	1	6.7
Rapids	35	195.4	.2	3,596	6	30.0
Rapid water		195.6	.2	3,602	1	5.0
Rapids	34	195.8	.1	3,603	2	20.0
Rapid water		195.9	.3	3,605	1	3.3
Rapids	33	196.2	.1	3,606	5	50.0
Rapid water		196.3	.2	3,611	1	5.0
Rapids	32	196.5	.1	3,612	5	50.0
Rapid water		196.6	.15	3,617	1	6.7
Rapids	31	196.75	.1	3,618	5	50.0
Rapid water		196.85	.6	3,623	3	5.0
Rapids	30	197.45	.1	3,626	4	40.0
Rapid water		197.55	.55	3,630	2	3.6
Rapids	29	198.10	.4	3,632	11	27.5
Rapid water		198.5	.25	3,643	2	8.0
Rapids	28	198.75	.2	3,645	13	65.0
Rapid water		198.95	1.0	3,658	15	15.0
Rapids	27	199.95	.3	3,673	16	53.3
Quiet water		200.25	.45	3,689	1	2.2
Rapids	26	200.7	.35	3,690	5	14.3
Rapid water		201.05	.35	3,695	1	2.9
Rapids	25	201.4	.1	3,696	5	50.0
Rapid water		201.5	.15	3,701	1	6.7
Rapids	24	201.65	.25	3,702	8	32.0
Rapid water		201.9	.15	3,710	2	13.3
Rapids	23	202.05	.15	3,712	9	60.0
Rapid water		202.2	.1	3,721	1	10.0
Rapids	22	202.3	.15	3,722	8	53.4
Rapid water		202.45	.1	3,730	1	10.0
Rapids	21	202.55	.25	3,731	10	40.0
Rapid water		202.8	.2	3,741	1	5.0
Rapids	20	203.0	.15	3,742	8	53.3
Rapid water		203.15	.35	3,750	2	5.7
Rapids	19	203.5	.2	3,752	6	30.0

Colorado River, Lees Ferry to mouth of Green River—Continued

Character of flow	No. of rapid	Beginning of stretch (miles above Lees Ferry)	Length of stretch (miles)	Elevation beginning of stretch	Fall, in feet	Fall, in feet per mile
Rapid water		203.7	1.3	3,758	7	5.4
Rapids	18–13	205.0	1.0	3,765	26	26.0
Rapid water		206.0	.9	3,791	5	5.6
Rapids	12–11	206.9	.4	3,796	6	15.0
Rapid water		207.3	.9	3,802	4	4.4
Rapids	10	208.2	.2	3,806	7	35.0
Quiet water		208.4	.1	3,813	(2)	(2)
Rapids	9	208.5	.15	3,813	4	26.7
Rapid water		208.65	.35	3,847	4	11.4
Rapids	8	209.0	.2	3,821	2	10.0
Rapid water		209.2	.2	3,823	1	5.0
Rapids	7–6	209.4	.45	3,824	12	26.7
Rapid water		209.85	.45	3,836	3	6.7
Rapids	5	210.3	.4	3,839	8	20.0
Quiet water		210.7	.15	3,847	(2)	(2)
Rapids	4	210.85	.25	3,847	8	32.0
Rapid water		211.1	.4	3,855	1	2.5
Rapids	3	211.5	.15	3,856	4	26.7
Quiet water		211.65	.25	3,860	(2)	(2)
Rapids	2	211.9	.15	3,860	5	33.3
Rapid water		212.05	.1	3,865	1	10.0
Rapids	1	212.15	.15	3,866	4	26.7
Quiet water		212.3	4.2	3,870	9	2.1
Mouth of Green		216.5		3,879		

COLORADO, MOUTH OF GREEN RIVER TO GRAND JUNCTION

The following two tables cover the stretch of Colorado River from the mouth of Green River, Utah, to Grand Junction, a distance of 173.1 miles. Mileage corresponds to mileage on the Plans and Profile sheets entitled "Plan and Profile of Grand (Colorado) River, Green River to Castle Creek, Utah (3 plans and 2 profiles), surveyed in 1912, and Plan and Profile Grand (Colorado) River, Grand Junction, Colorado, to Castle Creek, Utah (6 sheets), surveyed in 1911," and also mileage is given above Lee's Ferry.

The number of the rapids run consecutively upstream. The various stretches have been classified

entirely on the basis of the profiles, and it is entirely possible that a detailed field examination would show different classification with respect to rapid water and rapids. In many of the stretches classified as rapid water there are known to be riffles or what might be more accurately termed as small rapids.

Colorado River, Green River to Grand Junction

BEGINNING OF STRETCH

	No. of rapid	Miles above Lees Ferry	Miles above mouth Green River	Length of stretch	Elevation beginning of stretch	Fall in feet	Fall in feet per mile
Quiet water [1]		216.5	6	71.12	3,876	.81	.1.14
Rapid water		287.62	71.12	2.62	3,957	11	4.20
Rapid	1	290.24	73.74	.59	3,968	7	11.9
Quiet water		290.83	74.33	1.19	3,975	(2)	
Rapid	2	292.02	75.52	.73	3,975	11	15.1
Quiet water		292.75	76.25	.09	3,986	(2)	
Rapid	3	293.44	76.94	.38	3,986	4	10.5
Quiet water		293.82	77.32	1.16	3,990	3	2.6
			Miles below Grand Junction, Colo.				
Rapid	4	294.98	94.62	.82	3,993	17	20.7
Quiet water		295.80	93.80	.70	4,010	2	2.9
Rapid water		296.50	93.10	.38	4,012	2	5.3
Quiet water		296.88	92.72	1.57	4,014	(2)	(2)
Rapid	5	297.45	92.15	1.11	4,014	18	16.2
Rapid water		298.56	91.04	2.43	4,032	10	4.1
Rapid	6	300.99	88.61	.31	4,042	8	25.8
Rapid water		301.30	88.30	1.15	4,050	9	8.1
Quiet water		302.45	87.15	.50	4,059	1	2.0
Rapid water		302.95	86.65	1.07	4,060	5	4.7
Rapid	7	304.02	85.58	.08	4,065	3	37.5
Quiet water		304.10	85.50	1.90	4,068	2	1.1
Rapid water		306.00	83.60	4.28	4,070	14	3.3
Quiet water		[illegible]28	79.32	1.04	4,084	1	.9
Rapid water		[illegible]32	78.28	1.50	4,085	5	3.3
Quiet water		312.82	76.78	.68	4,090	(2)	
Rapid water		313.50	76.10	1.40	4,090	7.6	4.3
Quiet water		314.90	74.70	.35	4,096	(2)	
Rapid water		315.25	74.35	10.03	4,096	49	3.8

[1] In this stretch at mile 1.7 above mouth of Green River is located The Slide, which causes "rapid current" for short distance.

[2] Negligible.

Colorado River, Green River to Grand Junction—Continued

BEGINNING OF SURVEY—Continued

	No. of rapid	Miles above Lone Tree	Miles below Grand Junction, Colo.	Length of rapids	Elevation beginning of rapids	Fall in feet	Fall in feet per mile
Green water		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Rapid	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Green water		[illegible]	[illegible]	[illegible]	[illegible]		[illegible]
Rapid	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Do.	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Rapid water		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Rapid	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Green water		[illegible]	[illegible]	[illegible]	[illegible]		[illegible]
Rapid	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Rapid water		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Rapid	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Rapid water		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Green water		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Rapid water		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Rapid	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Green water		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Rapid	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Rapid water		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Rapid	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Rapid water		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Rapid	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Green water		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Rapid	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Rapid water		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Green water		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Rapid	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Rapid water		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Rapid	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Rapid water		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Rapids	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Green water		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Rapid water		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Rapids	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Rapid water		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Rapids	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Rapid water		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Rapids	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Green water		[illegible]	[illegible]	[illegible]	[illegible]		
Rapids	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Rapid water		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
		[illegible]	[illegible]		[illegible]		[illegible]

[1] Negligible.

GREEN RIVER, GREENRIVER, UTAH, TO MOUTH

Based on plan and profile of Green River, mouth to Gunnison Butte, Utah, by the U. S. Bureau of Reclamation as published in Water Supply Paper 396

(6 plans and 3 profiles) surveyed during 1914 and investigations by the writer during October, 1928.

Green River, Greendyer, Utah, to mouth of San Rafael River

Elevation Greendyer, Utah		4,046
Elevation at mouth of San Rafael		3,987
Total fall		59
Distance, 117.3–94.9		22.4
Fall per mile	[feet]	2.6

Of the total fall approximately 37 feet is concentrated at 15 riffles having a total length of 4.0 miles and an average drop of 9.3 feet to the mile. The average fall in the 18.4 miles between the riffles is 1.2 feet to the mile.

Green River, San Rafael River to Moab

Elevation at mouth of San Rafael River		3,987
Elevation at mouth of Green River		3,876
Total fall		111
Distance		94.9
Fall per mile	[feet]	1.17

Riverton

Fall per mile at 15 riffles having total length of 4.0 miles = 9.3 ft. per mi.

Fall elsewhere between riffles, Green River to San Rafael, distance 18.4 miles = 1.2 ft. per mi.

San Rafael River to mouth of Green = 1.17 ft. per mi.

Length of riffles and fall per mile[1]

Name	Miles above mouth	Length, miles	Fall, feet	Fall per mile, feet
Riverton	117.3	0.20	3.0	15
Ridge	108.2	0.10	3.0	30
Two Mile	111.1	0.6	3.0	5
Bonanza	110.1	0.3	3.0	10
Agate	110.1	0.6	3.0	5
Parson	111	0.3	3.0	10
Cable	106.6	0.9	3.0	3
Crossing	2 106.6	0.2	3.0	15
Rainbow	104.1	0.4	3.0	7.5
Mile-and-a-half	108.1	0.1	3.0	30
Cactus	103	0.5	3.0	6
Bonanza	102	0.7	3.0	4
Second Agate	101.4	0.7	3.0	4
First Agate	100	0.2	3.0	15
San Rafael	94.9	0.1	3.0	30
Total and average		4.07	51.1	9.3

[1] For more detailed information see report by W. G. Hoyt, entitled "Special Survey and Examination of Green and Colorado Rivers between Green River and Moab, February, 1928."

GREEN RIVER, WYOMING-UTAH STATE LINE TO GREEN RIVER, UTAH

The mileage on the following 6 tables refers to the mileage on the river survey maps entitled "Plan and profile of Green River, Greenriver, Utah, to Green River, Wyoming, 16 sheets (10 plan and 5 profile) surveyed 1904, 1913-1914, 1922." The rapids have been numbered consecutively downstream. The classification so far as the rapids are concerned, has been prepared by R. R. Woolley.

Green River, Greenriver, Utah, to Utah-Wyoming line

Character of flow	No. of rapid	Beginning of stretch: Miles above Lees Ferry, Arizona	Beginning of stretch: Miles above Greenriver, Utah	Length of stretch: Feet	Length of stretch: Miles	Fall in feet	Fall in feet per mile
							ft.
Quiet water		333.9	0		9.1	23	3.12
Rapids	1	341.9	8.1	1,700	32	8	25.0
Dam		342.22	8.42			3	
Quiet water		342.22	8.42		3.65	10	2.74
Rapids	2	343.87	12.07	600	08	6	100
Quiet water		345.95	12.15		3.35	17	5.08
Rapids	3	349.30	15.50	250	05	3	60
Quiet water		349.35	15.55	300	06		
Rapids	4	349.61	15.61	500	09	2	33.3
Quiet water		349.47	15.67	1,500	28	1	3.57
Rapids	5	349.73	15.93	300	06	4	66.7
Quiet water		349.91	16.01		5.0	19	3.22
Rapids	6	355.71	21.91	1,500	28	15	53.6
Quiet water		355.99	22.19		9.2	50	5.44
Rapids	7	365.19	31.39	1,600	30	12	66.2
Quiet water		365.45	31.65		4.96	32	6.45
Rapids	8	370.41	36.61	800	06	5	83.3
Strong current		370.47	36.67		1.97	16	8.12
Rapids	9	372.44	38.64	800	15	6	40.0
Swift current		372.59	38.79		10.11	108	10.80
Rapids	10	382.70	48.90	800	15	5	33.3
Quiet water		382.85	49.05	3,900	80	2	2.5
Rapids	11	383.65	49.85	900	17	3	17.9
Quiet water		383.82	50.02	4,700	89	9	10.1
Rapids	12	384.71	50.91	1,200	23	9	39.1
Strong current		386.94	51.14		16	15	9.38
Rapids	13	386.54	52.74	700	13	3	28.1
Quiet water		386.67	52.87	3,900	53	4	7.54
Rapids	14	387.20	53.40	100	19	5	26.3
Quiet water		387.39	53.59	1,200	23	2	8.7
Rapids	15	387.62	53.82	600	11	4	36.4

[1] Negligible.

Green River, Greenriver, Utah, to Utah-Wyoming line—Continued

Character of flow	No. of rapid	Beginning of stretch		Length of stretch		Fall in feet	Fall in feet per mile
		Miles above Lees Ferry, Arizona	Miles above Greenriver, Utah	Feet	Miles		
Quiet water		387.79	52.95	2,900	0.55	4	7.3
Rapids	16	388.29	54.49	900	.17	7	41.2
Quiet water		388.43	54.65	2,000	.38	1	2.63
Rapids	17	388.83	55.03	1,300	.25	5	20.0
Quiet water		389.09	55.28	2,300	.43	4	9.3
Rapids	18	389.31	55.71	800	.15	6	40.0
Strong current		389.66	55.86	2,200	.64	7	10.9
Rapids	19	390.30	56.50	600	.11	3	27.3
Strong current		390.41	56.61	1,200	.60	6	10.0
Rapids	20	391.01	57.21	600	.11	5	45.5
Quiet water		391.12	57.32	1,400	.26	2	7.7
Rapids	21	391.38	57.58	600	.11	5	45.5
Strong current		391.49	57.69	6,000	1.13	12	10.6
Rapids	22	392.62	58.82	1,000	.19	4	21.05
Quiet water		392.81	59.01	1,500	0.28	1	3.57
Rapids	23	393.09	59.29	500	.09	6	66.7
Quiet water		393.18	59.38	1,700	.32	1	3.12
Rapids	24	393.50	59.70	500	.09	3	33.3
Quiet water		393.59	59.79		1.7	9	5.3
Rapids	25	395.29	61.49	1,000	.19	5	26.3
Strong current		395.48	61.68		1.12	7	6.25
Rapids	26	396.60	62.80	600	.11	3	27.3
Quiet water		396.71	62.91		2.55	7	2.74
Rapids	27	396.26	63.47	800	.15	4	26.7
Quiet water		399.41	63.62		1.3	4	3.08
Rapids	28	400.73	66.91	700	.13	3	23.1
Quiet water		400.84	67.04		2.6	4	1.54
Rapids	29	403.44	69.64	1,800	.34	10	29.4
Quiet water		403.78	69.98		126.95	177	1.39
Rapids	30	530.73	196.93	800	.15	4	26.6
Quiet water		530.88	197.08		1.80	9	5.0
Rapids	31	532.68	198.88	800	.15	3	20.0
Quiet water		532.83	199.03		1.4	10	7.14
Rapids	32	534.23	200.43	300	.06	2	33.3
Strong current		534.29	200.49	1,600	.30	5	16.7
Rapids	33	534.59	200.79	300	.06	3	50.0
Quiet water		534.65	200.85	3,700	.70	2	2.86
Rapids	34	535.35	201.55	1,000	.19	7	36.8
Strong current		535.54	201.74	2,000	.38	6	80.0
Rapids	35	535.70	201.90	1,000	.19	5	26.3
Quiet water		535.89	202.09	800	.15	1	6.66
Rapids	36	536.04	202.24	1,100	.21	6	28.6
Quiet water		536.25	202.45	2,900	.55	5	9.1
Rapids	37	536.80	203.00	800	.15	7	46.6
Quiet water		536.95	203.15	1,300	.25	2	8.0
Rapids	38	537.20	203.40	1,300	.25	9	36.0
Strong current		537.45	203.65	1,600	.30	4	13.3
Rapids	39	537.75	203.95	400	.08	2	25.0
Quiet water		537.83	204.03	2,000	.38	4	10.5
Rapids	40	538.21	204.41	500	.09	5	55.6

Green River, Greenriver, Utah, to Utah-Wyoming line—Continued

Character of flow	No. of rapid	Beginning of stretch		Length of stretch		Fall in feet	Fall in feet per mile
		Miles above Lees Ferry, Arizona	Miles above Green-river, Utah	Feet	Miles		
Quiet water		538.30	204.59	800	0.15	1	6.66
Rapids	41	538.45	204.61	600	.11	9	97.6
Strong current		538.56	204.79	600	.11	2	18.2
Rapids	42	538.67	204.87	500	.09	3	33.3
Strong current		538.76	204.96	1,500	.28	5	17.86
Rapids	43	539.04	205.24	500	.09	7	77.8
Strong current		539.13	205.33	2,300	.43	8	18.6
Rapids	44	539.56	205.76	800	.17	8	47.1
Quiet water		539.73	205.93	700	.13	2	15.4
Rapids	45	539.86	206.06	1,100	.21	10	47.6
Quiet water		540.07	206.27		7.6	28	3.68
Rapids	46	547.67	213.87	500	.09	2	22.2
Quiet water		547.76	213.96	2,000	.38	4	10.5
Rapids	47	548.14	214.34	1,000	.19	3	15.8
Quiet water		548.33	214.53	2,000	.38	3	7.9
Rapids	48	548.71	214.91	1,060	.19	4	21.1
Quiet water		548.90	215.10	600	.11	1	9.1
Rapids	49	549.01	215.21	700	.13	3	23.1
Quiet water		549.14	215.34	600	.11	1	9.1
Rapids	50	549.25	215.45	900	.17	3	29.4
Strong current		549.42	215.62	700	.13	2	15.4
Rapids	51	549.55	215.75	600	.11	2	18.2
Quiet water		549.66	215.86	1,300	.23	[1]	
Rapids	52	549.89	216.09	1,400	.26	10	38.5
Quiet water		550.15	216.35	1,800	.34	2	5.9
Rapids	53	550.49	216.69	600	.11	2	18.2
Quiet water		550.60	216.80	1,700	.32	4	12.5
Rapids	54	550.92	217.12	600	.11	4	36.4
Quiet water		551.03	217.23	2,700	.51	1	1.9
Rapids	55	551.70	217.90	1,500	.28	9	32.1
Quiet water		551.98	218.18	3,000	.57	3	5.26
Rapids	56	552.55	218.75	500	.09	1	10.7
Quiet water		552.64	218.84	1,400	.26	4	15.4
Rapids	57	552.87	219.07	600	.11	2	25.0
Quiet water		552.96	219.15	2,400	.45	3	6.66
Rapids	58	553.40	219.60	600	.11	5	45.5
Quiet water		553.51	219.71		1.75	15	8.58
Rapids	59	555.26	221.46	300	.06	2	30.0
Quiet water		555.30	221.50		6.2	33	5.32
Rapids	60	561.50	227.70	1,200	.23	4	17.4
Quiet water		561.73	227.93		1.6	12	7.5
Rapids	61	563.33	229.53	500	.09	4	44.5
Quiet water		563.42	229.62	1,700	.32	3	9.4
Rapids	62	563.74	229.94	500	.09	1	10.7
Quiet water		563.80	230.00	1,300	.25	2	8.0
Rapids	63	564.05	230.25	700	.13	4	30.8
Strong current		564.18	230.38	600	.11	4	36.4
Rapids	64	564.29	230.49	200	.04	1	25.0
Quiet water		564.33	230.53	1,300	.25	1	4.0

[1] Negligible.

Green River, Greenriver, Utah, to Utah-Wyoming line—Continued

Character of flow	No. of rapid	Beginning of stretch: Miles above Lees Ferry, Arizona	Beginning of stretch: Miles above Greenriver, Utah	Length of stretch: Feet	Length of stretch: Miles	Fall in feet	Fall in feet per mile
Rapids	65	564.58	230.78	380	0.06	2	33.3
Strong current		564.64	230.84	1,400	.26	5	19.2
Rapids	66	564.90	231.10	700	.13	2	15.4
Quiet water		565.03	231.23	1,300	.25	1	4.0
Rapids	67	565.28	231.48	1,800	.34	27	79.4
Quiet water		565.62	231.82	2,200	.42	3	7.1
Rapids	68	566.04	232.24	1,700	.32	13	40.6
Quiet water		566.36	232.56	2,200	.42	1	2.4
Rapids	69	566.78	232.98	300	.06	1	16.7
Quiet water		566.84	233.04	700	.13	1	7.7
Rapids	70	566.97	233.17	600	.11	6	54.6
Quiet water		567.08	233.28	1,100	.21	(1)	
Rapids	71	567.29	233.49	700	.13	2	15.4
Strong current		567.42	233.62	1,400	.26	5	19.1
Rapids	72	567.68	233.88	400	.08	5	62.4
Strong current		567.76	233.96	600	.11	2	18.2
Rapids	73	567.87	234.07	600	.11	4	36.3
Strong current		567.98	234.18	800	.15	3	20.0
Rapids	74	568.13	234.33	400	.08	3	37.5
Strong current		568.21	234.41	900	.17	4	23.5
Rapids	75	568.38	234.58	500	.09	6	66.6
Quiet water		568.47	234.67	1,300	.25	1	4.0
Rapids	76	568.72	234.92	200	.04	3	75.0
Strong current		568.76	234.96	1,300	.25	5	33.3
Rapids	77	568.91	235.11	700	.13	3	23.1
Strong current		569.04	235.24	500	.09	2	22.2
Rapids	78	569.13	235.33	1,300	.25	6	24.0
Quiet water		569.38	235.58	500	.09	(1)	
Rapids	79	569.47	235.67	1,400	.26	5	19.2
Strong current		569.73	235.93	2,000	.38	7	18.4
Rapids	80	570.11	236.31	900	.17	9	53.0
Strong current		570.28	236.48	300	.06	1	16.7
Rapids	81	570.34	236.54	500	.09	4	44.5
Quiet water		570.43	236.63	600	.11	(1)	
Rapids	82	570.54	236.74	1,600	.30	20	66.6
Strong current		570.84	237.04	700	.13	2	15.4
Rapids	83	570.97	237.17	800	.15	5	33.3
Strong current		571.12	237.32	700	.13	4	30.8
Rapids	84	571.25	237.45	400	.08	3	37.5
Strong current		571.33	237.53	900	.17	2	11.8
Rapids	85	571.50	237.70	400	.08	2	25.0
Strong current		571.58	237.78	1,700	.32	5	15.6
Rapids	86	571.90	238.10	700	.13	5	38.5
Strong current		572.03	238.23	200	.04	(1)	
Rapids	87	572.07	238.27	1,100	.21	5	23.8
Strong current		572.28	238.48	2,000	.38	5	13.2
Quiet water		572.66	238.86		1.34	2	1.5
Rapids	88	574.00	240.20	400	.08	5	62.5
Quiet water		574.08	240.28	1,900	.36	3	8.3

1 Negligible.

Green River, Greenriver, Utah, to Utah-Wyoming line—Continued

Character of flow	No. of rapid	Beginning of stretch		Length of stretch		Fall in feet	Fall in feet per mile
		Miles above Lees Ferry, Arizona	Miles above Greenriver, Utah	Feet	Miles		
Rapids	89	574.44	240.64	400	0.08	3	37.5
Quiet water		574.52	240.72		26.8	56	2.1
Rapids	90	601.32	267.52	700	.13	2	15.4
Quiet water		601.45	267.65		10.8	85	7.9
Rapids	91	612.25	278.45	2,200	.42	16	38.1
Quiet water		612.67	278.87		.7	2	2.9
Rapids	92	613.37	279.57	1,500	.28	9	32.1
Quiet water		613.65	279.85	3,700	.70	3	4.3
Strong current		614.35	280.55		2.3	23	10.0
Quiet water		616.65	282.85	2,300	.43	1	2.3
Strong current		617.08	283.28	2,400	.45	5	11.1
Rapids	93	617.53	283.73	1,300	.25	8	32.0
Strong current		617.78	283.98	3,800	.72	12	16.7
Rapids	94	618.50	284.70	1,400	.26	7	26.9
Quiet water		618.76	284.96	1,300	.25	(1)	.....
Rapids	95	619.01	285.21	2,200	.42	10	23.8
Strong current		619.43	285.63	1,700	.32	2	6.4
Rapids	96	619.75	285.95	200	.04	2	50.0
Strong current		619.79	285.99		.9	5	5.5
Rapids	97	620.69	286.89	400	.08	1	12.5
Strong current		620.77	286.97		1.2	7	5.8
Rapids	98	621.97	288.17	400	.08	3	37.5
Strong current		622.05	288.25		.5	5	10.0
Quiet water		622.55	288.75		1.1	4	3.6
Strong current		623.65	289.85	2,300	.43	6	13.9
Rapids	99	623.91	290.18	1,500	.28	6	21.4
Quiet water		624.18	290.38	900	.17	(1)	.....
Strong current		624.35	290.55	1,850	.35	5	14.2
Rapids	100	624.70	290.90	300	.06	2	33.3
Quiet water		624.76	290.96		1.4	5	3.6
Ashley Falls	101	626.16	292.36	200	.04	3	75.0
Strong current		626.20	292.40		1.65	16	9.7
Quiet water		627.85	294.05		.34	1	2.9
Rapids	102	628.19	294.39	1,000	.19	4	21.1
Strong current		628.38	294.58	500	.09	2	22.2
Rapids	103	628.47	294.67	600	.11	3	27.3
Strong current		628.58	294.78	1,300	.12	3	25.0
Rapids	104	628.7	294.9	1,200	.23	5	21.7
Strong current		628.93	295.13	2,500	.47	5	10.6
Rapids	105	629.40	295.60	2,800	.53	13	24.5
Strong current		629.93	296.13	400	.77	8	10.4
Rapids	106	630.70	296.90	1,000	.19	4	21.1
Quiet water		630.89	297.09	2,800	.53	1	1.9
Rapids	107	631.42	297.62	1,500	.28	5	17.9
Quiet water		631.70	297.90	2,400	.45	1	2.2
Rapids	108	632.15	298.35	600	.11	4	36.4
Quiet water		632.26	298.46	2,300	.43	2	4.6
Strong current		632.69	298.89	800	.15	3	20.0
Rapids	109	632.84	299.04	1,200	.23	5	21.7

(1) Negligible.

Green River, Greenriver, Utah, to Utah-Wyoming line—Continued

Character of flow	No. of rapid	Beginning of stretch: Miles above Lees Ferry, Arizona	Beginning of stretch: Miles above Greenriver, Utah	Length of stretch: Feet	Length of stretch: Miles	Fall in feet	Fall in feet per mile
Quiet water		633.07	299.27	1,200	0.23	(1)	
Rapids	110	633.30	299.50	1,300	.25	7	28.0
Strong current		633.55	299.75	700	.13	3	23.1
Rapids	111	633.68	299.88	500	.09	5	55.6
Strong current		633.77	299.97	3,500	.66	7	10.6
Rapids	112	634.43	300.63	1,200	.23	5	21.7
Strong current		634.66	300.86	900	.17	2	11.8
Rapids	113	634.83	301.03	500	.09	1	11.1
Strong current		634.92	301.12	1,100	.21	3	14.3
Rapids	114	635.13	301.33	400	.08	1	12.5
Strong current		635.21	301.41	300	.06	1	16.7
Rapids	115	635.27	301.47	700	.13	5	38.5
Strong current		635.40	301.60	300	.06	1	16.7
Rapids	116	635.46	301.66	3,800	.72	14	19.4
Strong current		635.18	302.38	2,300	.43	5	11.6
Quiet water		636.61	302.81	900	.29	(1)	
Rapids	117	636.91	303.1	1,100	.21	6	28.6
Quiet water		637.55	303.75		.6	1	1.7
Rapids	118	637.76	303.96	1,100	.21	5	23.8
Strong current		637.89	304.09	700	.13	1	7.7
Rapids	119	638.02	304.22	900	.17	3	17.7
Strong current		638.19	304.39	1,000	.19	3	15.8
Rapids	120	638.38	304.58	700	.13	5	38.5
Strong current		638.51	304.71	1,700	.32	2	6.3
Rapids	121	638.83	305.03	600	.11	3	27.3
Strong current		638.94	305.14	2,100	.40	5	12.5
Rapids	122	639.34	305.54	1,200	.23	5	21.7
Strong current		639.57	305.77	1,200	.23	1	4.3
Rapids	123	639.80	306.00	1,100	.21	5	23.8
Quiet water		640.01	306.21	700	.13	(1)	
Rapids	124	640.14	306.34	600	.11	2	18.2
Strong current		640.25	306.45		1.7	8	4.7
Rapids	125	641.95	308.15	2,000	.38	6	15.8
Quiet water		642.33	308.53		6.5	8	1.2
Rapids	126	648.8	315.0	50	.01	0.5	50
Quiet water		648.84	315.04		6.5	13	2.0
Utah-Wyoming line		655.30	321.5				

[1] Negligible.

SAN JUAN RIVER, CHINLE CREEK TO MOUTH

The mileage on the following table refers to the mileage on the river survey maps entitled, "Plan and Profile San Juan River, mouth to Chinle Creek," surveyed during 1921 and also Miles above Lee's

Ferry, Arizona. The rapids are numbered consecutively in downstream order. The classification has been made on the basis of the profiles and information in Water Supply Paper No. 538, "The San Juan Canyon, Southeastern Utah," by Hugh D. Miser.

San Juan River, mouth of Chinle Creek

BEGINNING OF STRETCH

Character of flow	No. of rapid	Miles above Lee Ferry	Miles above mouth	Length of stretch miles	Elevation beginning of stretch	Fall in feet	Fall in feet per mile
Rapid water		78.0	0	10.64	3,257	59	5.54
Rapid	1	88.64	10.64	.38	3,316	9	23.7
Rapid water		89.02	11.02	.38	3,325	2	5.26
Rapid	2	89.40	11.40	.18	3,327	13	72.3
Rapid water		89.58	11.58	3.28	3,340	21	6.40
Rapid	3	92.86	14.86	.08	3,361	4	50.0
Rapid water		92.94	14.94	5.08	3,365	31	6.1
Rapid	4	98.02	20.02	.28	3,396	7	25.0
Rapid water		98.30	20.30	.44	3,403	3	6.8
Rapid	5	98.74	20.74	.36	3,406	9	25.0
Rapid water		99.10	21.10	.16	3,415	1	6.3
Rapid	6	99.26	21.26	.38	3,416	15	39.5
Rapid water		99.64	21.64	48.73	3,431	266	5.5
Rapid	7	148.37	70.37	.07	3,697	3	42.9
Rapid water		148.44	70.44	3.32	3,700	31	9.34
Rapid	8	151.76	73.76	1.01	3,731	17	16.8
Rapid water		152.77	74.77	2.47	3,748	17	6.9
Rapid	9	155.24	77.24	.08	3,765	3	37.5
Rapid water		155.32	77.32	.21	3,768	2	9.5
Rapid	10	155.53	77.53	.07	3,770	3	42.9
Rapid water		155.60	77.60	2.30	3,773	17	7.4
Rapid	11	157.90	79.90	.10	3,790	4	40.04
Rapid water		158.00	80.00	2.26	3,794	15	6.6
Rapid	12	160.26	82.26	.10	3,809	4	40.0
Rapid water		160.36	82.36	6.21	3,813	47	7.57
Rapid	13	166.57	88.57	.55	3,860	10	18.2
Rapid water		167.12	89.12	24.68	3,870	177	7.2
Rapid	14	191.80	113.80	.10	4,047	4	40.0
Rapid water		191.90	113.90	7.97	4,051	56	7.03
Rapid	15	199.87	121.87	.08	4,107	3	37.5
Rapid water		199.95	121.95	2.00	4,110	17	8.5
Rapid	16	201.95	123.95	.20	4,127	9	45.0
Rapid water		202.15	124.15	8.85	4,136	77	8.7
		211.00	133.00		4,213		

COMPLAINANT'S EXHIBIT 82

CHARACTERISTICS OF COLORADO, GREEN, AND SAN JUAN RIVERS AS SHOWN BY CURRENT METER DISCHARGE MEASUREMENTS AT BASE GAGING STATIONS

By W. G. Hoyt, Hydraulic Engineer, U. S. Geological Survey.

May 1929.

Although gaging stations are established and maintained primarily for the purpose of determining mean daily flow in second-feet the measurements made at the stations as a basis for the determination of the flow also furnish the most reliable data available as to permanency of channel conditions and make possible the determination of the relation not only between stage and discharge but also the relation between discharge and mean depth, discharge and mean velocity and discharge and maximum surface velocity. Such relations can only be determined at established gaging stations and although the determined relations strictly hold true only for the section at the gaging station they do give some idea of conditions in other reaches of the rivers.

Hundreds of discharge measurements have been made at the various gaging stations. It is manifestly impossible to use all the measurements in a study of this kind. An attempt has been made to use in each instance the results of a sufficient number of discharge measurements to insure that the results obtained will represent truly actual conditions. The original forms from which the observations have been taken are on file in various district offices of the

Geological Survey but in a few instances photostat copies have been made of survey forms showing the various elements making up the discharge measurements.

Unstability of river bed.—The soundings of depth made in connection with each discharge measurement being referred to a common datum and made in the same cross section show accurately the extent of scour or fill occurring during the interval between the measurements. Cross sections have been plotted of the soundings of a number of discharge measurements made at the following stations:

Colorado River near Cisco, Utah.
Colorado River at Lees Ferry, Arizona.
Green River near Green River [Greenriver], Utah.
San Juan River near Bluff, Utah.
Green River near Curay, Utah (maintained by the Utah Power & Light Company).

In considering the cross sections obtained at these various gaging stations it should be borne in mind that in order to obtain accurate records of discharge the engineer endeavors in so far as possible to locate gaging stations along straight stretches of the river where the bed is permanent and the flow distributed uniformly across the cross section. It seems reasonable to suppose, therefore, that the shifting character of the beds as disclosed by actual reference soundings represent conditions which are more stable than the average condition along the river as a whole.

On plates 1A to 6A the following symbols have been used:

(W) Width of water surface in feet at the time of measurement.
(A) The cross section of the river in square feet.

(MV) The mean velocity obtained by dividing the total discharge in second-feet by the cross section in square feet.

(GH) The average gage height in feet during the time of making the measurement.

(Dis) The discharge of the river in cubic feet per second based upon the observed velocities and area of cross section.

Plate I A. Colorado River near Cisco, Utah.—Observed variation in bed of river between December 9, 1922, and February 2, 1928. Data of special interest to show variation in the river bed which took place during the high water of May and June, 1923. For instance, between May 2 and May 23, the discharge increased from 12,000 to 34,200 second-feet which was accompanied by a scour at stations 235 and 310 amounting to 2.1 and 1.7 feet, respectively, and a fill at station 425 amounting to 2.3 feet. Between May 23 and June 14, additional fill occurred at stations 325 and 430, amounting to 2 feet and 0.6 feet, respectively.

Photo A shows the Colorado River at Cisco gaging station, November 11, 1914. Picture taken from right (west) bank, by E. W. Jordan, U. S. Geological Survey, at a gage height of 2.91 feet. Discharge, 3,460 feet at a stage 0.27 feet higher than measurement made December 9, 1922.

Plate II A. Colorado River at Lees Ferry.—Typical cross sections at the measuring cable showing range of stage and characteristic changes in bed of the river caused by scour and fill during a period November 22, 1924, to July 11, 1926. Changes in depth of as much as 17 feet are observed at station 440 near the left (south) bank between measurement No. 1 and measurement No. 4 although the stage of the water

was only 10.2 feet higher when measurement No. 4 was made.

Plate II A. Colorado River at Lees Ferry.—Typical cross sections at the measuring cable showing rapidity with which cross section may change caused by scour and fill. Cross sections are shown for May 2, 3, 4, 5, and 7, 1927, during which time the flow increased from 32,500 to 62,600 second-feet and a maximum scour of 5 feet occurred at station 250 near the right (north) bank, with an increase in stage of only 2 feet.

Photo E shows the measuring equipment at the cable section. Photo taken by G. C. Stevens, hydraulic engineer, September 22, 1923. Gage height 9.63 feet; discharge, 16,200 second-feet.

Plate IV A. Green River at Little Valley near Greenriver, Utah.—Bed composed of sand and gravel. Cross sections indicate changes which have occurred between April 9, 1915, and June 10, 1920.

Photo C shows Green River at Little Valley gaging station August 29, 1913. Picture taken from right (west) bank by Lynn Crandall, U. S. Geological Survey, at a gage height of 0.93 foot; discharge 2,360 second-feet, nearly the same stage and flow as measurement made August 8, 1915.

Plate V A. San Juan River near Bluff, Utah.—Bed of shifting sand. Cross sections show changes which have occurred between period June 19, 1915, and March 4, 1916. Cross sections are of interest to show the rapidity with which changes occur as noted by the different cross sections of the measurements made 6 hours apart on July 29, 1915.

Photo D shows San Juan River at gaging station near Bluff, Utah, October 31, 1914. Picture taken by L. W. Jordan, U. S. Geological Survey at a gage height of 3.10 feet; discharge 2,300 second-feet.

Plate VI A. Green River at gaging station maintained by Utah Power & Light Company, near Ouray, Utah.—Shows changes which have occurred during the period May 20, 1921, to September 17, 1926.

Photo B, Green River looking downstream from (east) bank October 14, 1917. Photo taken by employee of Utah Power & Light Company; discharge about 2,500 second-feet.

Discharge, mean velocity, maximum velocity, and mean depth—Plate 1.—Curves showing approximate relation between stage and—

(a) discharge in second-feet,
(b) mean velocity in miles per hour,
(c) maximum observed velocity in miles per hour,
(d) mean depth

for gaging station at Green River, Wyoming, based on open water measurements, 1921 to 1926.

Plate 2.—Curves similar to Plate 1 for gaging station Green River near Greenriver, Utah, based on open water measurements, 1916 to 1924.

Plate 3.—Curves similar to Plate 1 for gaging station Colorado River near Cisco based on open water measurements, 1914 to 1926.

Plate 4.—Curves similar to Plate 1 for gaging station, San Juan River near Bluff, Utah, based on open water measurements, 1916 to 1917.

Plate 5.—Curves similar to Plate 1 for gaging station Colorado River at Lees Ferry, Arizona, based on discharge measurements made during 1921–1922.

The curves on these plates showing the approximate relation between stage and discharge, stage and mean depth, stage and mean velocity, and stage and observed-velocity, are based on the results of current meter discharge measurements numbered as indi-

cated. They are titled "approximate" because on rivers with unstable beds and controls the absolutely correct relation can not be expressed by single curves. The extent to which the curves differ from the plotted points is an indication of the probable error in the various relations. Following is an example on the use of these curves.

Green River at Greenriver, Wyoming.—For example at gage height of 3.0 feet; from the curves the following is read:

Discharge in second feet = about 2,350.
Mean depth = about 5.5.
Mean velocity miles per hour [2] = about 1.67.
Maximum velocity miles per hour = about 2.86.

For a given flow as for instance 5,000 second feet, the curve is entered from the 5,000 second-foot line vertically to the stage-discharge line and then horizontally giving the following:

Gage height = about 3.9 feet.
Mean depth = about 6.2 feet.
Mean velocity = 2.36 miles per hour.
Maximum velocity = 3.5 miles per hour.

Similar information may be obtained for any gage height or any flow at the various gaging stations.

Maximum observed velocity.—Plate 7 shows by means of curves the maximum surface velocity in miles per hour for the different gaging stations and the number of days in the year these surface velocities may be expected. These curves were plotted from the data on Plates 1 to 5, inclusive, used in connection with Plate 6. For instance Plate 6 shows

[2] All field observations are made in feet per second. For the purpose of this discussion all units in feet per second have been transposed to miles per hour by the factor .68182.

that on the Colorado River at Cisco a flow of 4,000 second-feet or over occurs for 175 days. On Plate 3 it is seen that for a flow of 4,000 second-feet corresponding to a gage height of 2.9 feet at which stage the maximum velocity is about 1.90 miles per hour. The other points on the maximum velocity curve are obtained in a similar manner. The plotted points of observed maximum velocity on Plates 1 to 5 are based on the current meter observations made in connection with the discharge measurements, the plotted observations being the observations taken in the thread of the stream at a point two-tenths of the total depth below the surface.

Mean velocity.—Plate 8 shows by means of curves the mean velocity (total discharge in second-feet divided by area in square feet) in miles per hour for the different gaging stations and the number of days in the year these mean velocities may be expected. These curves are plotted from the data on Plates 1 to 5 and used in connection with Plate 6. For instance, Plate 6 shows that on the Colorado River at Cisco a flow of 4,000 second-feet or over occurs for 175 days. On Plate 3 it is seen that for a flow of 4,000 second-feet corresponds to a stage of 2.9 feet, at which gage height the mean velocity is about 1.55 miles per hour. The plotted points of mean velocity on Plates 1 to 5 are based upon the results of current meter measurements and are obtained for each measurement by dividing the total measured discharge in second-feet by the total area of cross section in square feet.

Mean Depth.—Plate 9 shows by means of curves the mean depth in feet and the number of days in the year these mean depths may be expected. These

curves are plotted from the data on Plates 1 to 5 and used in connection with the data on Plate 6. As has been shown a stage of 2.9 feet at Cisco corresponds to a flow of 4,000 second-feet and a mean depth of 3.8 feet. Other points on the curve are obtained in a similar manner.

The plotted points of mean depth on Plates 1 to 5 are based upon the results of the discharge measurements and are obtained by dividing the total area of the cross section in square feet by the width of the water surface.

Width of water surface.—On Plate 10 are shown for the various gaging stations by means of curves the approximate relation between the width in feet and mean depth in feet. Data from which these curves were plotted were taken from the results of discharge measurements.

Distribution of velocity in the vertical.—Plates 11 A and 11 B show the distribution of velocity at different points in the cross section at the Lees Ferry gaging station, based on current meter observation made May 31, 1924. These curves are typical of thousands of so-called vertical velocity curves made by the Geological Survey.

Distribution of velocity in the cross section.—Plate 12 shows the distribution of velocity in the cross section at the Lees Ferry gaging station. The lines of equal velocity are based upon the same observations shown on Plates 11 A and 11 B. These curves show graphically the magnitude of errors that may be involved in attempting to arrive at a mean velocity in a river and thus the discharge by the use of a float in the thread of the maximum velocity. For this particular measurement the maximum velocity was 8.86 miles per hour and the mean velocity only 5.91 miles per hour.

SLOPE AND MEAN VELOCITY STAGE AND "c" IN CHEZY FORMULA

Certain discharge measurements made at Lees Ferry during 1921 and 1922 were referred to two gages about 0.67 mile apart thus making it possible to determine the slope of the water surface at the time of the discharge measurement. From these measurements it should be possible to determine the approximate relation between slope, velocity, stage, and "c" in Chezy formula ($V=c\sqrt{RS}$ when $V=$ velocity, $R=$ hydraulic radius, and $S=$ slope (drop in feet divided by distance in feet).) The following table (No. 1) shows the results of the discharge measurements. Based on these 14 measurements, which cover a range in flow from 10,700 to 98,500 second-feet, it was found impossible to obtain any fixed relation between stage, slope, and velocity. When it is considered that such large changes take place in the cross section as are indicated on Plate 2.A, it is evident that a definite relation is not to be expected.

TABLE NO. 1.—*Colorado River at Lees Ferry, Arizona*

(Data with reference to certain measurements made during 1921 and 1922)

No.	Date	Gage height		Elevation of water		Difference in elevation (feet)	Fall per mile (feet)	Observed mean velocity		Area of cross section sq. ft.	Discharge, second-feet
		No. 4 gage[1] (feet)	No. 1 gage[1] (feet)	No. 4 gage (feet)	No. 1 gage (feet)			Feet per second	Miles per hour		
2	8/5/21	11.12	14.73	3,118.12	3,117.52	0.60	.0893	5.20	3.54	4,580	23,800
8	8/14/21	9.37	13.29	3,116.37	3,116.08	.29	.432	4.02	2.74	3,480	14,000
14	8/22/21	11.28	14.93	3,118.28	3,117.72	.56	.833	6.27	4.28	3,860	24,200
15	8/26/21	14.44	18.13	3,121.44	3,120.92	.52	.774	8.55	5.83	6,380	54,100
25	9/5/21	10.65	14.34	3,117.65	3,117.13	.52	.774	5.55	3.78	3,710	20,600
130	4/28/22	9.52	12.95	3,116.52	3,115.74	.78	1.16	5.93	4.04	2,170	12,900
119	3/24/22	10.88	14.38	3,117.88	3,117.17	.71	1.06	7.12	4.85	3,020	21,500
133	4/27/22	12.95	16.00	3,119.95	3,118.79	1.16	1.73	8.83	6.02	3,850	34,000
138	5/4/22	15.20	18.5	3,122.20	3,121.29	.91	1.35	8.91	6.02	6,150	54,800
152	5/24/22	17.78	21.35	3,124.78	3,124.14	.64	.95	9.86	6.72	7,970	78,600
162	6/6/22	17.92	21.35	3,124.92	3,124.14	.78	1.16	8.41	5.73	9,950	83,700
170	6/15/22	19.90	23.00	3,126.90	3,125.79	1.11	1.65	8.49	5.79	11,600	98,500
188	8/25/22	9.96	13.7	3,116.96	3,116.49	.47	.70	6.18	4.21	2,830	17,500
189	8/29/22	8.60	12.35	3,115.60	3,115.14	.46	.69	4.15	2.83	2,580	10,700

[1] Distance between gage No. 4 and gage No. 1 about 0.672 mile.

Table No. 2 shows the computed value of "c" based on the measured slope, area, width, and velocity. The table shows a similar lack of any relation, with a variation in "c" from 92 to 198, or over 100 per cent as compared to changes in "c" of from 68 to 78 for the Snake River at King Hill, Idaho, and 107 to 112 for the Columbia River at the Vermita Wash. (Unpublished data in the files of the United States Geological Survey).

TABLE NO. 2.—*Colorado River at Lees Ferry, Arizona*

Relation between stage and "c" in Chezy formula—$V=c\sqrt{RS}$

(Based on certain discharge measurements made during 1921 and 1922)

No.	Date	Gage height	Slope	Area, sq. ft.	Width, feet	B	C
2	8/7/21	11.12	0.000169	4,580	382	12.0	116
8	8/14/21	9.37	.000082	3,480	374	9.3	146
14	8/22/21	11.28	.000158	3,860	384	10.0	157
15	8/26/21	14.44	.000147	6,330	399	15.9	176
25	9/3/21	10.65	.000147	3,710	380	9.8	146
130	4/28/22	9.32	.000220	2,170	375	5.8	171
119	3/24/22	10.88	.000200	3,020	382	7.9	180
133	4/27/22	12.95	.000327	3,850	392	9.8	155
138	5/4/22	15.20	.000257	6,150	402	15.3	143
152	5/24/22	17.78	.000180	7,970	416	19.2	169
162	6/6/22	17.92	.000220	9,950	416	23.9	118
170	6/15/22	19.90	.000313	11,690	426	27.2	92
188	8/25/22	9.96	.000133	2,830	378	7.5	198
189	8/29/22	8.60	.000130	2,580	372	6.9	138

COMPLAINANT'S EXHIBIT 85

BRIEF DESCRIPTION OF COLORADO, GREEN, SAN JUAN RIVERS AND TRIBUTARIES COMPILED FROM WATER SUPPLY PAPERS AND RIVER SURVEY MAPS

By W. G. Hoyt, Hydraulic Engineer, United States Geological Survey, June, 1929

Colorado River

ABOVE THE MOUTH OF THE GREEN RIVER

Colorado River and its tributaries above the mouth of the Green River drain an area comprising approximately 26,500 square miles of which 22,200 square miles are in Colorado and 4,300 square miles are in Utah. On the east and southeast the basin is bounded by the high ranges of the Continental Divide, which separate it from the basins of the Platte and Arkansas rivers; on the north it is limited by the White River and Book Cliffs plateau, and on the west by the Colorado River Plateau. Colorado River rises among the high peaks of the Rocky Mountains in north central Colorado and flows southwestward to its junction with Green River traversing approximately 423 miles.

PRINCIPAL TRIBUTARIES OF COLORADO ABOVE MOUTH OF GREEN RIVER

Roaring Fork.—Enters Colorado River at Glenwood Springs, drains a large area in Pitkin County, Colorado, and reaches the Continental Divide. It

is one of the largest tributaries of the Colorado. Frying Pan Creek and Crystal River are its most important branches.

Gunnison River.—Gunnison River is formed in Gunnison County, Colorado, by the union of East and Taylor Rivers, two streams whose origin is among the slopes of the Continental Divide. They flow in narrow mountain valleys and unit about 12 miles above Gunnison. From the junction of these rivers the Gunnison flows west and southwest to its union with Colorado River at Grand Junction, 389.6 miles above Lees Ferry and 173.1 miles above the mouth of Green River. The principal tributaries of the Gunnison River are Ohio, Tomichi, Lake Fork, and Cimarron creeks, and Smith, North Fork, and Uncompahgre rivers.

Dolores River.—The Dolores River rises in the La Plata and San Miguel mountains. After flowing southwesterly about 50 miles the river turns to the west and enters Colorado River about 15 miles west of the Colorado-Utah line, 313.8, miles above Lees Ferry and 97.3 miles above the mouth of the Green. San Miguel River is the principal tributary to the Dolores River.

The following smaller tributaries and washes enter Colorado River below the mouth of Dolores River. Mileage is given above Lees Ferry and also above the mouth of the Green River.

	Enters from—	Miles above Lees Ferry	Miles above Green River
Onion Creek	Left	302.7	86.2
Rock Creek	do	301.3	84.8
Castle Creek	do	295.7	79.2
Salt Wash	Right	292.8	76.3
Nigger Bill Creek	Left	284.9	68.4
Sheep Creek	do	284.5	68.0
Court House Wash	Right	281.2	64.7
Mill Creek	do	279.0	62.5
Kane Spring Wash	Left	276.0	59.5
Lockhart Canyon	do	243.5	27.0
Indian Creek	do	233.2	16.7
Salt Wash	do	220.2	3.7

Green River.—Green River and its tributaries drain an area comprising a large part of western Wyoming, northwestern Colorado, and eastern Utah, bounded on the north and east by the Wind River Mountains and the ranges forming the Continental Divide, on the south and east by the White River Plateau and the Book Cliffs and on the north and west by the Gros Ventre and Wyoming mountains and the Great Wasatch range. The area is roughly triangular in shape, its greatest length, north and south, is 370 miles and its greatest width 240 miles. The total area is approximately 45,000 square miles.

The river heads on the western slope of the Wind River Mountains in western Wyoming. For about 25 miles the river flows northwestward through the mountains; it then turns abruptly and runs in a generally southerly direction across western Wyoming into Utah. The most important tributaries in Wyoming are East Fork River, Big Sandy Creek, LaBarge Creek, Fontanelle Creek, and Blacks Fork.

Between Green River, Wyoming and the Wyoming-Utah boundary the Green [River] passes through an open canyon for approximately 70 miles. Just south of the boundary there is an open valley, com-

prising several square miles, in which Henrys Fork enters from the west. Immediately below the mouth of Henrys Fork the river enters Flaming Gorge (Mile 318 to 316) and Horseshoe Canyon (Mile 316 to 313). Below Horseshoe Canyon which is 3 miles long, the course of the river is eastward through Kingfisher (Mile 310.5 to 309), and Red canyons (Mile 307 to 275) and Browns Park (Mile 275 to 244) into Colorado for a distance of 35 miles, passing through Ladore (Mile 243 to 225) and Whirlpool canyons (Mile 223 to 214). Just above Whirlpool Canyon it is joined from the east by Yampa River.

Turning back into Utah the Green flows southwesterly through Island Park (Mile 214 to 209) and Split Mountain Canyon (Mile 207 to 200) into an open valley in the vicinity of Jensen and Ouray where it is joined by the Duchesne from the west and White River from the east. A few miles below the mouth of Duchesne River and White River the Green passes into a 120-mile canyon, the upper section of which is known as Desolation Canyon (Mile 117 to 39) and the lower as Gray Canyon. Near the lower end of Gray Canyon (Mile 39 to 12) it is joined by Price River from the west.

About 7 miles below the mouth of Price River the Green passes out of Gray Canyon into Green River Valley in which the town of Green River is situated. Twenty-five miles below Green River [Greenriver], Utah, the San Rafael, the last large tributary of the Green, enters from the west. From the mouth of the San Rafael to the junction of the Green and Colorado rivers the Green River flows through a box canyon, the walls of which in many places rise almost vertically from the water edge to a height ranging from 700 to 1,000 feet. Below the San Rafael, in

Labyrinth and Stillwater canyons the course of the Green [River] is very tortuous. The distance by straight line from the mouth of the San Rafael to the mouth of Green River is 34 miles; the distance by river is 95 miles.

PRINCIPAL TRIBUTARIES

Blacks Fork.—Blacks Fork with its numerous tributaries drains the extreme southwestern part of Wyoming. Enters Green River 355.5 miles above Green River [Greenriver], Utah, and 472.8 miles above the mouth.

Henrys Fork.—Henrys Fork rises on the northern slope of the Uinta Mountains and flows northward into Wyoming; returning to Utah it joins Green River about one-half mile above Flaming Gorge 318.5 miles above Green River [Greenriver], Utah, and 435.8 miles above mouth of the river.

Yampa River.—Yampa River rises in the southeastern part of Routt County, Colorado, flows northward to Steamboat Springs and thence westward to its junction with Green River just east of the Colorado-Utah boundary, 225.1 miles above Greenriver, Utah, and 342.4 miles above the mouth. Throughout almost its entire course it occupies a succession of open valleys alternating with deep, narrow canyons, the largest and deepest canyon being that through which it enters the Green [River].

Ashley Creek.—Ashley Creek rises on the southern slope of the Uinta Mountains in Uinta County, Utah, flows southeastward and joins Green River 3 miles below Jensen, 179.3 miles above Greenriver, Utah, and 296.6 miles above the mouth.

Duchesne River.—Duchesne River, one of the most important tributaries of the Green [River], rises in the

Wasatch and Uinta mountains, flows eastward and joins Green River at Ouray; 128.1 miles above Greenriver and 245.4 miles above the mouth.

White River.—White River rises in Trappers Lake which lies at an elevation of 9,500 feet in eastern Garfield County, Colorado. Thence it flows westward to its confluence with Green River in west-central Uinta County, Utah, 128.1 miles above Green River, [Greenriver, Utah] and 245.4 miles above the mouth. Throughout its course it occupies a narrow mountainous valley in which parks and canyons alternate.

Price River.—Price River, a rather important tributary of the Green River, has its source in the Wasatch Mountains, flows southeasterly and joins Green River in Gray Canyon 18.1 miles above Green River, [Greenriver] Utah, and 135.4 miles above the mouth.

San Rafael River.—San Rafael River is formed at a point about 10 miles below Castledale, Utah, by the junction of Ferron, Cottonwood, and Huntington creeks, streams whose sources lie in the Wasatch Mountains. The general course of the San Rafael River is southeastward to its confluence with Green River, 94.9 miles above the mouth.

The following smaller tributaries enter Green River below Green River, Wyoming:

	Enter from—	Miles above Greenriver, Utah	Miles above mouth
Patter Creek	Right	369.1	488.4
Sage Creek	Left	359.7	477.0
Currant Creek	do	353.0	470.3
Upper Marsh Creek	do	337.0	454.3
Lower Marsh Creek	do	333.0	450.3
Chokecherry Draw	do	319.1	436.4
Sheep Creek	Right	309.2	426.5
Skull Creek	do	298.9	416.2
Trail Creek	do	294.8	412.1
Allen Creek	do	294.7	412.0

	Enter from—	Miles above Green river, Utah	Miles above mouth
Dutch John Draw	Left	291.0	408.3
George Creek	Right	282.9	400.2
Little Davenport Creek	do	282.1	399.4
Jackson Creek	do	280.5	397.8
Red Creek	Left	278.9	396.2
Willow Creek	do	263.1	380.4
Grouse Creek	Right	263.0	379.3
Beaver Creek	Left	260.3	377.6
Vermillion Creek	do	248.2	362.5
Pot Creek	Right	235.2	352.5
Rippling Brook	do	230.5	347.8
Alcove Brook	Left	228.5	345.8
Pool Creek	do	224.5	341.8
Jones Hole Creek	Right	218.7	336.0
Sage Creek	do	217.2	334.5
Red Wash Canyon	do	214.0	331.3
Spring Creek	do	212.5	329.8
Red Wash	do	189.1	306.4
Cockleburr Creek	Left	183.1	300.4
Willow Creek	do	120.0	237.3
Dutch Spring Wash	Right	109.5	226.8
Sand wash	do	95.6	212.9
Nine Mile Creek	do	93.7	211.0
Tabyago Creek	Left	86.8	204.1
Temple Canyon	Right	84.6	201.9
Rock House Canyon	do	74.0	191.3
Jack Creek	do	69.1	186.4
Cunepah Canyon	Left	65.9	183.2
Cedar Ridge Canyon	Right	65.5	182.8
Flat Canyon Creek	do	63.0	180.3
Rock Creek	do	54.0	171.3
Snap Canyon	do	54.2	168.5
Three Canyon Creek	do	49.8	167.1
Florence Creek	Left	39.1	156.4
Range Creek	Right	31.5	148.8
Cool Creek	Left	26.1	143.4
Poverty Canyon	do	25.3	142.6
Rattle Snake Creek	do	22.1	139.4
Coal Canyon	do	14.5	131.8
Saleratus Wash	Right		117.1
Five Mile Wash	do		109.0
Milk Shake Creek	do		108.6
Salt Wash Canyon	Left		103.3
Horseshoe Canyon	Right		58.0
Hell Roaring Canyon	Left		53.8
Mineral Canyon	do		43.0
Beaver Creek	Right		14.3

COLORADO RIVER, MOUTH OF GREEN RIVER TO LEES FERRY

From the junction of the Green and Colorado rivers the Colorado flows in a generally southwesterly direction across southeastern Utah crossing into Arizona 27.5 miles upstream from Lees Ferry and 189 miles downstream from the mouth of the Green. Throughout its course the river is deeply intrenched in the Colorado River Plateau. Almost immediately below the Green the Colorado enters Cataract Canyon with its 48 cataracts in a distance of less than 40 miles. In the 180 miles between Cataract Canyon and Lees Ferry the Colorado flows in Glen Canyon. The principal tributaries to the Colorado in the stretch are the Fremont, Escalante, San Juan, and Paria rivers.

Freemont River.—The Freemont River, originally named the Dirty Devil, rises in the eastern slope of the Wasatch Mountains, flows in a generally southerly direction to Thurber, thence easterly to Hanksville where it turns southward and joins Colorado River 169.5 miles above Lees Ferry. Curtis Creek (Muddy River) is the principal tributary to the Freemont. Throughout its lower course the Freemont flows through deep canyons.

Escalante River.—Escalante River rises in the southern part of Garfield County, Utah, under the walls forming the east face of Table Cliff Plateau flows first northeast, then east and finally southeast and enters Colorado River 10 miles above the mouth of San Juan River and 88.2 miles above Lees Ferry. The lower three-fourths of its course is through a narrow deep canyon.

San Juan River.—San Juan River rises in San Juan Mountains in southwestern Colorado, flows south-

westerly into New Mexico, then turns west and northwest, across the extreme southwest corner of Colorado into San Juan County, Utah, in the southwestern part of which it unites with the Colorado, 78 miles upstream from Lees Ferry. The drainage area is about 25,800 square miles and includes part of four states. The principal tributaries of the San Juan that enter from the north are Navajo, Peidra, Pine, Florida, Animas, La Plata and Mancos rivers, McElmo, Montezuma, Hallett, Butler, Wash and Comb Wash, Lime and Johns Canyon, Slick Horn Canyon and Grand Gulch Creeks; Animas River is the most important. The streams that enter from the south are Choco River, Chinle, Gypsum, Moonlight, Copper, Nokai and Piute creeks.

Paria River.—Paria River rises in the Escalante Mountains in Garfield County, Utah, flows southeasterly through Kane County into Arizona and joins Colorado in the vicinity of Lees Ferry.

Minor tributaries, Colorado River between mouth of Green and Lees Ferry

	Enters from—	Miles above Lees Ferry
Gypsum Canyon	Left	196.5
Clearwater Canyon	Right	192.0
Dark Canyon	Left	182.7
North Wash	Right	167.7
Farley Canyon	Left	163.1
White Canyon	do	162.9
Trachyte Creek	Right	161.5
Two Mile Creek	do	159.4
Four Mile Creek	do	158.0
Red Canyon	Left	149.7
Tieaboo Creek	Right	148.4
Seven Mile Creek	do	139.0
Cedar Canyon	Left	136.6
Warmspring Creek	Right	136.6
Knowles Canyon	Left	134.4
Smith Fork	Right	132.0
Hansen Creek	do	130.0
Moki Creek	Left	125.0
Bull Frog Creek	Right	120.5
Halls Creek	do	118.3
Lake Canyon	Left	113.2

Minor tributaries, Colorado River between mouth of Green and Lees Ferry—Continued

	Enters from—	Miles above Lees Ferry
Navajo Creek	Right	95.5
Hole In Rock Creek	do	84.5
Oak Creek	Left	71.5
Aztec Creek	do	68.6
Rock Creek	Right	55.7
West Canyon Creek	Left	50.8
Last Chance Creek	Right	49.4
Kane Creek	do	40.6
Cottonwood Canyon	do	33.3
Warm Creek	do	27.9
Navajo Creek	Left	25.4
Wahweap Creek	Right	16.8
Ferry Swale	do	10.9

COMPLAINANT'S EXHIBIT 89

U. S. Geological Survey records, daily and monthly discharge Colorado River near Cisco, Utah, 1914—17 and 1923—28.

[Appendix A [1]]

COLORADO RIVER NEAR CISCO, UTAH

Location.—In NW. ¼ Sec. 17, T. 23 S., R. 24 E., 1 mile below mouth of Dolores River, 15 miles by road south of Cisco, Grand County, and 90 miles above confluence with Green River.

Drainage area.—24,100 square miles (measured on Gerneal Land Office maps).

Records available.—November, 1914, to September, 1917, and October, 1922, to September, 1927. Records were obtained at Moab, 25 miles downstream, from October, 1913, to November, 1914; flow practically the same at both sites.

Gage.—Water-stage recorder used during entire record at present site. At Moab staff and chain gages were used.

Discharge measurements.—Made from cable 400 feet below gage.

Channel and control.—Channel straight for several hundred feet above and below station. Left bank high and not subject to overflow; right bank in extreme floods is overflowed half a mile below. Bed composed of sand and gravel. Control is believed to be a rock ledge a quarter of mile below gage; fairly permanent.

[1] Appendix A to report, "Stream Flow Characteristics at Base Gaging Station, Colorado, Green, and San Juan Rivers."

Daily discharge, in second-feet, of Grand [Colorado] River near Cisco, Utah, for the year ending September 30, 1915

[Drainage area, 23,800 square miles]

Day	October discharge	November discharge	December discharge	January discharge	February discharge	March discharge	April discharge	May discharge	June discharge	July discharge	August discharge	September discharge
1			2,880			2,780	3,840	22,500	20,300	19,400	4,820	1,680
2			2,880			2,700	3,840	20,700	23,400	18,500	4,390	1,550
3			2,780			2,620	3,840	17,700	28,700	16,800	3,980	1,540
4			2,480			2,530	4,380	14,700	28,200	16,000	3,590	2,300
5			2,380			2,450	5,990	13,500	25,100	14,700	3,220	2,010
6			2,570			2,370	7,250	12,300	22,900	13,900	2,780	1,690
7			2,680			2,280	8,230	11,900	22,500	14,700	2,890	1,940
8			2,570			2,200	7,900	10,300	21,200	14,300	2,890	1,660
9			2,680			2,490	8,560	9,600	19,900	12,700	2,890	1,560
10		3,710	2,570			2,780	7,900	8,900	20,700	11,100	3,980	1,520
11		3,580	2,380			2,880	7,900	8,560	24,300	10,700	4,820	1,790
12		3,450	2,200			3,100	7,900	8,900	29,600	10,700	4,530	1,800
13		3,450	2,200			3,140	7,900	11,900	33,600	11,100	3,850	1,660
14		3,330	Ice			3,170	9,240	17,700	31,800	10,700	3,460	1,560
15		3,450				3,210	11,100	23,400	26,000	9,970	3,220	1,580
16		3,450				3,210	11,500	23,800	22,900	9,590	3,220	1,660
17		3,210				3,210	10,700	23,800	22,900	9,210	2,890	1,660
18		3,210				2,990	9,960	24,700	25,100	8,390	2,780	1,660
19		2,880				2,990	10,700	25,600	27,300	7,750	2,680	1,980
20		2,880				2,780	11,500	24,700	27,700	7,110	2,580	1,840
21		2,680				2,680	12,300	23,400	30,800	6,480	2,300	1,660
22		2,780				2,380	13,900	22,900	31,800	6,170	2,220	1,610
23		2,680				2,380	13,900	20,700	30,400	5,710	2,130	1,580
24		2,680				2,480	13,500	19,400	30,400	5,260	2,390	1,620
25		2,680				2,570	12,300	19,900	29,500	5,260	2,480	4,640
26		2,680				2,990	11,900	21,600	27,700	5,710	2,130	4,560

Ice — Est. Mean = 2,200

Ice — Est. Mean = 2,130

Est. Mean = 2,780 — Est. mean = 2,290

27		2,680				3,210	11,100	22,100	26,800	5,710	1,970	3,830
28		2,780				3,210	11,500	21,200	25,100	5,860	2,050	3,700
29		2,780				3,585	13,100	19,000	22,900	5,860	2,130	3,700
30		2,780				3,710	17,700	18,600	21,100	5,710	1,920	3,580
31						3,970		19,400		5,410	1,670	
Total		63,800	72,850	65,720	70,980	89,040	291,330	563,360	780,600	310,460	99,650	65,150
Mean	6,080	3,040	2,350	2,120	2,540	2,870	9,710	18,200	26,000	10,000	3,210	2,170
Second-feet per square mile												
Run-off depth, in inches		181,000										
Run-off in acre-feet	374,000	127,000	144,000	130,000	141,000	176,000	578,000	1,120,000	1,550,000	615,000	184,000	129,000
Maximum		3,710	2,880			3,970	17,700	25,600	33,600	19,400	4,820	4,640
Minimum		2,680				2,200	3,840	8,560	19,900	5,260	1,670	1,520
Accuracy		B	C	D	D	C	B	B	B	B	B	B

Daily discharge, in second-feet, of Grand [Colorado] River near Cisco, Utah, for the year ending Sept. 30, 1916

[Drainage area 23,800 square miles. Gage, Stevens continuous recording]

[File number, Washington 4169. Table of use: Half tenths 2.0 feet to 4.0 feet. Used rating table dated August 8, 1917]

NOTE.—Maximum stage recorded 13.9 feet at 7 p. m. May 11 (discharge, 47,800 second-feet).

Day	October discharge	November discharge	December discharge	January discharge	February discharge	March discharge	April discharge	May discharge	June discharge	July discharge	August discharge	September discharge
1	3,340	2,470	2,380			3,440	7,690	28,200	30,900	23,700	12,500	4,640
2	3,340	2,380	2,470			3,140	7,130	22,400	32,700	22,400	13,100	4,760
3	3,340	2,470	2,560	2,600		2,940	6,860	19,000	33,200	21,600	13,800	4,530
4	3,340	2,380	2,750			2,750	7,690	17,300	33,200	20,300	17,300	4,310
5	3,140	2,380	2,660			3,440	8,270	17,300	34,600	18,600	14,200	4,090
6	3,140	2,380	2,750	[18] 2,950		4,870	7,980	19,800	35,000	17,300	14,200	4,200
7	3,140	2,560	2,840			4,310	7,410	25,500	34,160	16,500	13,800	4,090
8	3,040	3,340	2,940			3,870	6,860	32,700	33,200	15,300	14,200	4,090
9	2,940	2,840	2,840			3,550	6,210	37,400	31,400	15,300	13,800	4,200
10	2,750	3,550	2,750			3,550	6,080	42,600	33,200	15,700	12,100	5,830
11	2,660	3,140	2,660			3,870	7,130	46,900	36,400	16,900	[19] 11,400	6,080
12	2,560	3,040	2,660			4,200	9,180	[20] 46,900	39,300	16,100	10,800	6,600
13	2,660	2,750	2,560			4,870	9,500	44,000	40,200	14,900	13,800	6,600
14	2,470	2,470	2,560		3,200	5,580	10,100	[21] 40,200	41,200	13,500	14,900	6,470
15	2,380	2,380	2,660			6,340	10,500	36,000	[22] 41,600	12,800	13,800	6,340
16	2,660	2,380	2,750	3,000		6,080	10,100	30,900	40,200	12,500	13,100	5,960
17	2,560	2,290	2,750			5,830	11,400	24,200	39,300	12,100	12,100	5,580
18	[17] 2,660	2,560	2,630			6,340	13,500	20,300	[23] 39,300	12,500	10,100	5,220
19	2,560	2,660	2,500			7,130	15,300	19,000	39,300	11,800	9,180	4,870
20	2,750	2,750	2,390			7,980	14,900	18,600	39,700	11,100	8,270	4,640
21	2,940	2,840				9,500	13,100	22,000	38,800	10,500	7,690	4,530
22	2,750	2,940				12,800	12,100	22,400	35,500	9,500	7,410	4,310
23	2,750	3,040				16,100	13,500	22,400	[24] 32,700	9,180	6,860	4,200

24	2,660	3,240				16,100	16,100	22,000	29,100	8,570	6,080	4,090
25	2,660	3,240				12,100	18,200	21,100	26,400	8,270	5,830	3,980
26	2,470	3,140	2,300			10,100	20,300	22,000	25,500	8,270	5,460	4,090
27	2,660	3,040	↓	[19] 3,190	[20] 3,340	8,870	22,000	22,800	25,000	8,870	5,340	4,090
28	2,660	2,750	↓	↑	3,660	7,980	23,700	23,700	24,600	11,100	5,100	4,090
29	2,560	2,750	↓	3,100	3,660	8,270	26,800	24,600	24,600	12,100	4,870	3,980
30	2,470	2,660	↓	↓	------	8,870	30,900	25,900	24,200	11,800	4,870	3,760
31	2,470	------	↓	↓	------	8,270	------	28,200	------	11,400	4,760	------
Total	86,480	83,110	78,350	91,540	93,860	213,040	380,490	846,300	1,014,400	430,460	320,720	144,220
Mean	2,790	2,770	2,530	2,950	3,240	6,870	12,700	27,300	33,800	13,900	10,300	4,810
Second-feet per square mile	------	------	------	------	------	------	------	------	------	------	------	------
Run-off, depth in inches	------	------	------	------	------	------	------	------	------	------	------	------
Run-off in acre-feet	172,000	165,000	156,000	181,000	186,000	422,000	756,000	1,680,000	2,010,000	855,000	633,000	286,000
Maximum	3,340	3,550	2,940	------	------	16,100	30,900	46,900	41,600	23,700	17,300	6,600
Minimum	2,380	2,290	------	------	------	2,750	6,080	17,300	24,200	8,270	4,760	3,760
Accuracy	------	------	------	------	------	------	------	------	------	------	------	------

Daily discharge, in second-feet, of Grand [Colorado] River near Cisco, Utah, for the year ending September 30, 1917

[Drainage area, 23,800 square miles. Gage, Stevens continuous recorder]

[File number, Washington 4169. Table of use: Half tenths 2.0 ft. to 4.0 ft. Used rating table dated 8/8/17 and 10/18/17]

NOTE.—Max. stage recorded, 19.7 feet at 9.00 p. m. June 19 (discharge, 74,700 sec.-ft.).

Day	October discharge	November discharge	December discharge	January discharge	February discharge	March discharge	April discharge	May discharge	June discharge	July discharge	August discharge	September discharge
1	3,980	↑	2,840	↑	↑	↑	6,080	12,300	↑	53,700	13,100	3,870
2	4,310	↑	2,840	↑	↑	3,000	5,830	12,800	22,000	51,200	12,100	3,660
3	3,870	4,300	2,840	↑	↑	5,220	↑	↓	46,400	↑	3,660	
4	5,580	↑	2,840	↑	↑	↓	4,980	↑	24,200	41,600	10,400	3,550
5	5,340	↑	2,940	↑	↑	3,200	4,640	12,600	30,900	37,900	↓	3,340
6	5,580	4,090	2,970	↑	↑	↑	3,980	↓	36,900	35,000	8,270	3,240
7	11,800	↑	3,000	↑	↑	↑	3,660	12,500	34,600	33,200	8,270	3,440
8	12,100	↑	3,040	↑	↑	3,070	3,550	11,100	41,600	31,800	7,980	3,440
9	8,270	↑	2,200	↑	↑	↑	3,660	11,100	53,700	30,400	7,410	3,040
10	10,800	↑	2,290	↑	↑	↓	4,640	10,800	57,600	30,900	6,600	3,240
11	14,200	3,500	2,290	↑	↑	2,940	5,340	10,800	61,400	29,500	6,340	4,760
12	10,800	↑	2,030	↑	↑	2,940	6,080	12,100	65,200	28,600	6,340	4,340
13	↑	↑	2,840	↑	↑	2,940	7,410	14,200	↑	26,400	6,600	4,640
14	8,700	↑	3,040	↑	↑	2,840	9,180	17,300	↑	24,600	7,690	4,530
25	↓	↑	2,940	2,000	2,500	↑	10,800	22,000	68,200	21,600	8,270	4,640
16	6,600	↑	2,840	↑	↑	↑	9,820	33,200	↓	20,300	7,690	4,640
17	6,600	↑	2,750	↑	↑	2,890	8,570	46,400	↑	18,600	6,860	4,530
18	6,340	↑	2,840	↑	↑	↓	7,690	53,200	71,200	16,500	6,340	4,420
19	6,340	↑	2,940	↑	↑	2,940	7,690	54,700	73,200	15,300	6,340	4,200
10	6,340	↑	2,840	↑	↑	2,940	7,690	53,200	↑	15,300	6,340	4,090
21	6,080	2,940	2,750	↑	↑	3,040	6,600	48,300	↑	14,900	5,830	3,870

22	5,830	2,940	3,040			3,040	6,600	39,300	69,700	14,900	5,340	3,760
23	5,460	2,840	2,940			3,140	8,570	32,300	↓	13,800	4,980	3,660
24	5,340	3,040	↑			3,140	12,800	31,400	66,200	13,100	4,760	3,760
25	5,340	3,040				3,040	16,500	30,400	↑	13,500	4,420	3,550
26	5,460	3,040				3,040	19,000	28,300	63,400	14,900	4,090	3,550
27	5,100	2,840	2,500			3,240	19,800	26,300	↓	14,600	4,200	3,550
28	↓	2,840				3,140	19,000	24,200	60,700	14,600	3,760	3,550
29	5,000	2,840				3,340	17,700	↑	57,200	13,100	3,870	3,550
30	↓	2,840				4,090	14,200	22,000	55,200	12,800	3,980	3,550
31		↓	↓	↓	↓	5,580	↓	↓	↓	13,800	3,980	↓
Total	213,560	103,790	83,880	62,000	70,000	97,480	267,280	764,600	1,665,800	762,800	212,950	116,620
Mean	6,890	3,460	2,710	2,000	2,500	3,140	8,910	24,700	55,500	24,600	6,870	3,890
Run-off in acre-feet	424,000	206,000	167,000	123,000	139,000	193,000	530,000	1,520,000	3,300,000	1,510,000	422,000	231,000
Maximum	14,200	↓	↓	↓	↓	5,580	19,800	54,700	73,200	53,700	13,100	5,340
Minimum	3,870	↓	↓	↓	↓	↓	3,550	10,800	↓	12,800	3,760	3,400

Daily discharge, in second-feet of Colorado River near Cisco, Utah, for the year ending September 30, 1923

[Drainage area, 24,100 square miles. Gage read to hundredths four times daily. An recorder installed 12-7-22]

[File number Washington 4169. Used rating table dated 6-28-23]

NOTE.—Maximum stage, 14.10 from 3 to 7 a. m. May 29; discharge, 47,500 second-feet. Minimum discharge, less than 2,000 second-feet about October 1.

	October discharge	November discharge	December discharge	January discharge	February discharge	March discharge	April discharge	May discharge	June discharge	July discharge	August discharge	September discharge
1		2,940	3,120	4,000	2,760	2,790	3,330	11,900	40,500	27,100	7,260	4,950
2		2,870	3,160	3,400	2,920	2,720	3,750	12,200	41,900	25,900	8,710	5,330
3		3,090	3,050	2,900	2,780	2,830	4,340	12,800	41,900	24,600	9,040	5,470
4		3,220	3,070	2,920	2,650	3,090	4,670	14,900	42,800	22,300	9,920	5,540
5		3,550	3,260	2,950	2,280	3,220	4,360	18,000	43,100	20,500	9,290	5,130
6	2,000	3,330	3,220	2,980	2,200	3,010	3,790	21,600	40,500	19,900	8,860	4,900
7		3,590	3,090	3,000	2,340	2,850	3,450	24,800	37,000	18,800	8,060	4,740
8		3,280	3,010	2,900	2,460	2,670	3,940	27,100	34,900	18,600	7,250	4,630
9		3,160	[28] 3,140	3,200	2,650	3,070	4,760	28,800	34,000	20,600	[34] 6,450	4,900
10		2,970	3,240	3,500	2,850	3,030	5,040	30,800	34,500	20,400	5,670	4,610
11		3,330	3,050	3,400	2,740	2,920	5,520	32,500	34,200	20,700	6,250	4,340
12		3,390	2,900	3,250	2,790	2,990	5,990	34,100	34,000	20,600	6,170	4,020
13	2,150	3,470	3,050	3,100	2,560	2,990	6,400	31,500	35,800	18,900	7,710	3,900
14	2,210	3,330	3,430	2,900	2,850	2,780	8,320	27,800	38,100	17,500	9,360	3,770
15	2,280	3,200	3,650	2,700	2,720	2,780	8,860	24,500	40,700	17,300	12,400	4,130
16	2,340	2,920	3,690	2,600	2,810	2,760	8,860	21,600	42,100	17,200	13,400	4,020
17	[27] 2,340	3,050	3,590	2,520	2,810	2,650	8,550	20,700	43,800	17,200	12,500	3,830
18	2,340	2,940	3,370	2,480	2,880	2,600	9,480	21,800	44,200	16,000	11,900	4,060
19	2,310	3,180	3,050	2,400	2,900	2,530	10,700	22,900	41,200	15,700	11,200	5,280
20	2,330	3,310	2,670	2,900	2,870	2,460	11,800	26,100	37,200	15,100	11,100	5,130
21	2,380	3,200	2,450	3,430	2,880	2,600	12,200	30,800	35,800	14,900	11,000	5,330
22	2,400	3,140	2,500	3,300	2,830	2,920	11,200	34,200	35,200	15,100	9,930	5,350
23	2,340	3,200	2,450	3,100	3,050	2,780	10,100	34,500	33,300	14,300	9,170	5,210

24	2,510	3,160	2,400	2,950	3,030	2,740	8,590	31,000	31,500	13,600	8,680	7,040
25	2,430	3,050	2,500	2,800	3,010	2,580	7,620	30,800	31,700	12,700	7,910	6,060
26	2,340	2,920	2,600	2,830	3,050	2,500	7,040	35,800	32,400	11,900	7,210	5,790
27	2,480	3,030	2,800	3,030	3,070	2,560	7,210	41,200	33,500	11,000	6,530	5,890
28	2,510	3,090	3,000	2,920	2,990	2,630	8,170	45,600	34,500	10,290	5,790	5,840
29	2,780	2,900	3,250	2,789		2,650	9,360	47,100	32,200	9,320	5,470	5,540
30	2,760	3,090	3,500	2,690		2,790	10,160	44,200	29,500	8,350	5,300	5,660
31	2,620		3,770	2,810		3,030		40,700		7,680	4,830	
Total	69,850	94,900	95,090	92,540	77,730	86,520	217,600	882,300	1,112,000	523,950	264,230	150,090
Mean	2,250	3,160	3,070	2,990	2,780	2,790	7,250	28,600	37,100	16,900	8,520	5,000
Run-off in acre-feet	138,000	188,000	189,000	184,000	154,000	172,000	432,000	1,750,000	2,210,000	1,040,000	524,000	298,000
Maximum	2,780	3,590	3,770	4,000	3,070	3,220	12,200	47,100	44,200	27,100	13,300	7,040
Minimum		2,870	2,400	2,400	2,200	2,460	3,330	11,900	29,500	7,680	4,830	3,770

Daily discharge, in second-feet, of Colorado River near Cisco, Utah, for the year ending September 30, 1924

[Drainage area, 24,100 square miles. Gage, Au recorder. Used rating table dated 6-28-23].

[Maximum stage, 14.90 feet at 10 a. m. on June 16. Discharge, 51,300 second-feet. Minimum stage, 1.14 feet at 8 p. m. on September 3. Discharge, 844 second feet. Corrections in red according to memo. of 4-29-27.]

	October discharge	November discharge	December discharge	January discharge	February discharge	March discharge	April discharge	May discharge	June discharge	July discharge	August discharge	September discharge
1	5,490	4,250	3,160	2,880		2,850	2,790	9,830	23,700	15,200	2,850	958
2	5,540	4,190	3,570	2,210		2,920	2,620	10,700	21,800	14,000	2,830	970
3	5,590	4,230	3,590		2,500	2,830	2,450	13,300	21,000	13,000		899
4	5,250	4,300	3,390			2,970	2,700	17,100	22,000	11,800		866
5	5,180	4,280	3,530			3,070	2,900	21,600	25,100	10,600		982
6	5,250	4,170	3,240			2,880	3,650	24,400	31,300	10,100	2,440	877
7	5,280	4,020	3,010	2,200	2,690	2,780	5,060	25,100	36,200	9,820		922
8	5,400	3,980	3,120			2,600	6,910	23,900	41,000	9,890		982
9	5,300	4,000	3,010			2,670	9,570	23,700	37,500	10,500	2,040	982
10	5,130	4,000	3,300			2,650	11,300	26,200	34,000	11,200	1,940	7,840
11	5,110	7,020	2,970		3,400	2,620	11,900	24,500	30,400	11,900	1,810	3,370
12	4,970	5,690	2,460			2,430	12,700	25,700	34,300	10,700	1,720	3,010
13	4,830	4,760	2,300			2,870	12,400	26,500	38,200	9,860	1,610	2,560
14	4,740	4,520	2,300			2,790	13,200	27,700	42,100	8,890	1,760	2,400
15	4,860	4,300	2,400			2,720	16,300	28,800	46,000	7,970	2,120	2,200
16	4,880	4,080	2,400			2,880	18,000	29,200	49,900	7,210	2,280	2,230
17	4,720	3,960	2,400	2,500	4,000	2,830	15,100	28,900	46,000	6,430	1,980	2,200
18	4,560	3,920	2,360			2,690	11,200	31,400	42,000	6,090	1,840	2,200
19	4,470	3,810	2,400			2,650	9,040	33,100	38,100	6,060	1,900	2,210
20	4,340	3,580	2,560		4,080	2,630	8,290	32,600	34,200	5,920	1,750	2,200
21	4,210	3,570	2,810		3,980	2,670	9,670	31,400	30,200	5,400	1,560	2,200
22	4,130	3,570	3,010		4,020	2,630	12,200	29,600	26,300	4,900	1,540	2,180
23	4,880	3,560	3,550		3,590	2,670	14,300	28,600	22,400	4,340	1,450	2,180
24	5,470	3,450	3,410		3,370	2,700	16,200	27,500	21,400	3,870	1,380	2,170

25	4,880	3,690	2,960		3,160	2,650	17,900	25,200	20,800	3,670	1,310	2,280
26	4,700	3,670	2,830		2,990	2,790	17,000	24,200	20,000	3,260	1,230	2,280
27	4,500	3,650	3,070		2,830	2,580	14,300	26,200	19,400	3,010	1,090	2,150
28	4,390	3,640	3,510	2,600	2,870	2,700	12,100	29,900	18,300	2,870	1,010	2,020
29	4,360	3,390	3,350		2,870	2,940	10,900	31,000	17,200	2,870	1,040	1,940
30	4,340	3,260	3,300			3,180	10,200	28,600	16,400	2,870	1,010	2,050
31	[40] 4,390		3,430			3,100		26,400		2,870	958	
Total	151,140	122,580	92,640	75,790	95,250	85,740	313,050	791,630	907,200	237,070	56,648	62,378
Mean	4,880	4,090	2,990	2,440	3,280	2,770	10,400	25,500	30,200	7,650	1,830	2,080
Run-off in acre-feet	300,000	243,000	184,000	150,000	189,000	170,000	619,000	1,570,000	1,800,000	470,000	113,090	124,000
Maximum	5,590	7,020	3,590			3,180	18,000	33,100	49,900	15,200	2,850	7,840
Minimum	4,130	3,260	2,300			2,430	2,450	9,830	16,400	2,870	958	866

Daily discharge, in second-feet, of Colorado River near Cisco, Utah, for the year ending September 30, 1925

[Drainage area, 27,100 square miles. Gage au continuous]

[Used rating table dated 6-28-23 as standard]

Maximum stage 9.86 feet at noon on June 1, 1925; discharge, 28,200 second-feet; minimum stage not recorded. Corrections by memo. of 4-29-27.

	October discharge	November discharge	December discharge	January discharge	February discharge	March discharge	April discharge	May discharge	June discharge	July discharge	August discharge	September discharge
1	2,070	3,310	2,740				6,640	10,200	27,700	13,300	4,000	7,260
2	2,170	3,280	2,600				6,910	11,200	25,700	12,900	3,960	6,660
3	2,150	3,160	2,810				6,610	12,400	21,400	13,000	3,570	6,480
4	2,150	3,280	2,790			3,000	6,300	14,300	18,300	12,600	3,590	10,900
5	2,120	3,370	2,810				6,300	16,400	15,900	12,700	3,610	7,860
6	2,170	3,510	2,940				7,120	17,100	14,800	13,300	3,750	7,800
7	2,310	3,530	2,850				8,500	16,700	14,800	12,900	3,530	7,260
8	3,300	3,490	2,830			3,590	8,380	15,900	14,800	11,700	3,490	6,610
9	3,570	3,240	2,700			3,830	7,120	15,600	14,200	10,400	3,220	5,960
10	3,180	3,180				4,020	6,040	15,500	13,500	9,420	2,880	5,710
11	3,330	3,280				3,790	6,120	15,400	12,800	9,200	3,310	5,450
12	3,670	3,260	2,650			3,490	7,230	15,100	13,800	9,230	5,400	5,200
13	3,550	3,260			6	3,180	9,640	14,700	15,700	9,700	5,570	4,950
14	3,590	3,240	2,740		2,600	3,000	12,000	14,000	14,900	9,420	5,790	4,900
15	3,530	3,200	3,260			2,850	12,700	14,200	13,900	8,530	6,140	4,900
16	3,510	3,160	2,920			2,700	13,400	14,400	15,700	7,460	5,720	4,670
17	3,550	3,180	2,810			2,560	13,400	14,000	19,000	6,690	4,970	4,580
18	3,650	3,090	2,790			2,740	13,300	13,900	21,200	6,400	4,280	4,520
19	3,590	3,240	2,740			2,720	13,300	14,600	21,400	6,040	4,360	7,510
20	3,590	3,390	2,600			2,650	13,200	17,700	21,600	5,940	4,100	9,610
21	3,790	3,370	2,400			2,620	12,500	21,200	22,900	6,320	4,500	9,960
22	3,770	3,330	2,200			2,700	11,200	23,800	24,900	8,350	4,100	7,740
23	3,960	3,240	2,000			2,810	11,700	23,400	27,900	9,260	4,170	6,690

24	3,550	3,260	1,500			3,180	11,100	22,700	25,500	9,390	5,040	5,990
25	3,570	3,240				4,000	9,860	23,700	22,400	7,970	7,260	5,620
26	3,450	2,990				4,700	8,800	23,700	19,900	7,120	6,990	5,400
27	3,300	2,690				5,040	8,230	23,000	17,500	6,510	7,210	5,180
28	3,240	2,600				5,540	8,470	22,600	16,100	6,020	7,970	4,830
29	3,200	2,580	1,300			5,820	8,920	23,700	14,600	5,520	7,540	4,450
30	3,240	2,810				5,840	9,570	24,800	13,400	5,020	7,910	4,130
31	3,350					6,090		25,900		4,360	7,120	
Total	99,170	95,760	75,330	68,200	72,800	110,460	284,560	551,800	555,100	276,670	155,050	188,780
Mean	3,200	3,190	2,430	2,200	Est.2,600	3,560	9,490	17,800	18,500	8,920	5,000	6,290
Run-off in acre-feet	197,000	190,000	149,000	135,000	144,000	219,000	565,000	1,090,000	1,100,000	548,000	307,000	374,000
Maximum	3,960	3,530	3,260			6,090	13,400	25,900	27,700	13,300	7,910	10,900
Minimum	2,070	2,580				2,560	6,040	10,200	12,800	4,360	2,880	4,130

Daily discharge, in second-feet, of Colorado River near Cisco, Utah, for the year ending September 30, 1926

[Drainage area, 24,100 square miles. Gage, all continuous]

[Used rating table dated 10-23-26]

Maximum stage, 15.2 feet at 4 p. m. on May 27; discharge, 52,400 second-feet; minimum stage, 1.60 feet at 5 a. m. on Sept. 27; discharge 1,430 second-feet.

	October discharge	November discharge	December discharge	January discharge	February discharge	March discharge	April discharge	May discharge	June discharge	July discharge	August discharge	September discharge
1	3,810	4,320	3,310			2,340	3,290	26,300	34,600	17,400	4,500	1,620
2	3,690	4,430	3,220			2,420	3,430	25,500	37,900	17,900	4,200	1,560
3	3,390	4,790	3,260			2,470	3,390	24,500	41,300	17,800	4,000	1,540
4	3,270	4,890	3,350			2,610	3,450	26,600	43,200	16,700	3,900	1,510
5	5,200	4,630	3,240		2,700	2,880	3,290	28,800	44,600	16,000	3,800	1,470
6	13,000	4,350	2,990			3,140	3,510	32,300	44,800	17,400	5,500	1,460
7	5,880	3,940	3,100			3,270	4,390	35,800	45,200	18,100	5,500	1,470
8	5,470	3,830	3,160	2,400		2,950	6,950	31,700	46,800	20,400	5,000	1,650
9	5,220	3,920	3,080			2,540	9,070	27,900	45,200	22,700	5,000	1,670
10	5,030	3,830	3,030				8,600	22,500	43,700	20,800	5,500	1,820
11	5,670	3,730	2,770		2,700		7,650	18,700	41,300	18,800	5,500	1,810
12	6,610	3,790	2,650		2,680	3,800	8,040	16,200	39,300	16,000	5,200	1,810
13	5,800	3,730	2,650		2,660		8,720	15,000	38,300	14,000	4,600	1,790
14	6,090	3,860	2,650		2,880		8,630	13,800	37,900	13,000	4,000	1,810
15	6,170	3,770	2,650		2,750		8,880	13,500	35,800	12,000	3,400	1,880
16	5,780	3,710	2,680		2,660	3,060	9,520	13,400	34,600	11,000	3,300	1,840
17	5,320	3,430	2,580		2,720	3,590	13,100	15,000	32,600	10,000	3,000	1,880
18	5,130	3,490	2,540	2,200	2,580	3,810	12,400	17,300	29,400	9,500	2,800	1,790
19	5,010	3,550	2,560		2,520	4,060	14,000	19,200	25,430	9,000	2,800	1,760
20	4,890	3,530	2,560		2,420	4,240	16,700	20,900	22,700	8,000	2,600	1,750
21	4,770	3,350	2,600		2,380	4,320	18,200	24,200	21,600	7,600	2,400	1,750
22	4,570	3,180	2,500		2,440	4,410	20,100	29,800	21,000	7,300	2,300	1,940

23	4,540	3,140	2,450	2,100	2,360	4,210	22,400	33,400	19,500	6,800	2,200	1,720
24	4,630	3,160	2,400		2,410	3,940	22,600	37,200	18,200	6,200	2,100	1,580
25	4,660	3,240	2,500		2,330	4,460	23,900	40,800	18,200	5,600	1,900	1,480
26	4,660	3,410	2,650		2,230	5,060	23,800	41,900	18,200	5,300	2,100	1,510
27	4,570	3,510	2,800		2,360	4,820	24,400	47,500	18,000	5,000	2,020	1,600
28	4,460	3,470	2,830	2,300	2,360	4,460	25,100	42,100	18,000	5,000	1,900	1,760
29	4,390	3,370	2,750			4,000	24,000	38,300	18,400	5,200	1,750	1,680
30	4,320	3,330	2,560			3,710	24,600	35,200	17,800	5,500	1,680	1,880
31	4,320		2,560	2,700		3,450		34,200		5,500	1,670	
Total	160,320	112,680	86,630	71,700	72,440	107,020	386,110	849,500	953,500	371,500	106,120	50,790
Mean	5,170	3,760	2,790	2,310	2,590	3,450	12,900	27,400	31,800	12,000	3,420	1,690
Run-off in acre-feet	318,000	224,000	172,000	142,000	144,000	212,000	768,000	1,680,000	1,890,000	738,000	210,000	101,000
Maximum	13,000	4,890	3,350	2,700	2,880	5,060	25,100	47,500	46,800	22,700	5,500	1,940
Minimum	3,270	3,140	2,400		2,230	2,340	3,290	13,400	17,800	5,000	1,670	1,460

Daily discharge, in second-feet, of Colorado River near Cisco, Utah, for the year ending September 30, 1928

Maximum stage, 17.32 feet at 6 p. m. on June 1; discharge, 65,000 second-feet; minimum stage, 2.08 feet at 7 a. m. on Aug. 25; discharge, 2,310 second-feet.

[Gage au recorder. Used rating table dated Oct. 23, 1926, as standard]

	October discharge	November discharge	December discharge	January discharge	February discharge	March discharge	April discharge	May discharge	June discharge	July discharge	August discharge	September discharge
1	7,800	7,500	4,170		3,460	3,240	7,200	27,500	62,200	25,000	6,780	3,570
2	8,070	5,080	3,920		[1]3,490	3,310	7,270	32,200	62,200	24,000	6,280	3,180
3	7,740	4,840	3,860		3,350	3,350	7,650	41,600	57,000	22,500	6,980	3,180
4	7,330	4,610	3,980		3,350	3,790	8,980	42,400	51,000	20,800	6,200	3,100
5	7,210	4,390	3,830		3,610	4,060	8,940	33,300	43,900	19,400	6,580	2,990
6	7,090	4,300	3,650		4,150	3,810	7,860	28,600	35,200	18,860	6,040	2,880
7	7,010	4,590	3,500		4,150		6,990	29,800	30,900	17,300	5,780	2,750
8	6,840	4,660	3,510		3,750		6,120	33,700	30,400	16,500	5,320	2,560
9	6,640	4,630	3,700		3,510		5,250	37,700	32,300	15,100	4,820	2,520
10	6,360	4,700	3,900		3,120		5,010	43,800	34,000	13,600	4,560	2,360
11	6,060	4,660	4,050		3,220		4,770	46,900	33,500	12,800	3,980	2,420
12	5,880	4,590	4,040		3,160		5,100	46,000	3,300	[2]12,100	3,690	2,540
13	5,670	4,610	4,020		3,240	3,590	5,370	41,600	28,500	11,800	3,490	2,580
14	5,400	4,570	3,960	3,400	3,180		5,370	36,500	25,500	11,100	3,490	2,610
15	5,270	4,770	3,750		3,080		5,060	34,100	22,200	11,100	3,530	2,610
16	5,150	4,820	3,650		3,330		4,390	31,500	20,300	10,700	3,960	2,580
17	5,150	4,610	3,600		3,160		4,480	30,000	20,800	10,600	4,170	2,560
18	5,130	4,630	3,600		3,260		5,420	29,300	23,200	11,400	3,940	2,540
19	5,100	4,770	3,630		3,220	3,370	6,580	27,700	26,000	13,000	3,390	2,540
20	4,940	4,680	3,700		3,240	3,390	7,830	26,800	24,800	12,500	3,200	2,490
21	4,890	4,630	3,750		[1]3,180	3,410	8,440	28,000	22,000	12,100	2,990	2,460
22	4,910	4,500	3,750		3,160	3,750	8,380	29,100	20,100	11,400	2,700	2,840
23	4,940	4,480	3,700		3,200	4,570	8,040	[1]31,500	20,800	10,700	2,490	3,260
24	4,910	4,430	3,650		3,200	5,340	8,190	34,100	23,000	9,890	[2]2,420	3,270
25	4,820	4,240	3,600		3,180	5,800	10,600	36,900	24,800	9,390	2,330	3,080

26	4,790	4,040	3,650		3,120	6,010	13,800	40,300	26,300	8,600	2,440	2,930
27	4,590	3,940	3,700		3,120	7,270	14,900	45,600	26,300	8,010	2,860	2,830
28	4,700	3,960	3,150		3,180	8,600	18,200	51,100	27,900	7,360	3,920	4,410
29	5,830	4,260	3,800		3,240	9,690	21,600	55,400	27,900	6,980	3,650	3,310
30	4,610	4,210	3,750	3,390		8,470	24,300	58,300	27,000	6,640	3,350	3,030
31	5,830		3,600	3,420		7,700		59,700		6,610	3,410	
Total	180,660	138,700	116,720	105,410	96,610	142,010	262,090	1,171,000	941,300	407,780	128,680	85,980
Mean	5,830	4,620	3,770	3,400	3,330	4,580	8,740	37,800	31,400	13,200	4,150	2,870
Run-off in acre feet	358,000	275,000	232,000	209,000	192,000	282,000	520,000	2,320,000	1,870,000	812,000	255,000	171,000
Maximum	8,070	7,500	4,170		4,150	9,690	24,300	59,700	62,200	25,000	6,980	4,410
Minimum	4,590	3,940	3,500		3,080	3,240	4,390	26,800	20,100	6,610	2,330	2,360

Daily discharge, in second-feet, of Colorado River near Cisco, Utah, for the year ending September 30, 1927

Maximum stage, 14.48 feet at 6 a. m. on May 20; discharge 49,000 second-feet. A.—From comparison with combined flow of Colorado—Palisade and Gunnison—Grand Junction.

[Gage read to au recorder. Used rating table dated [illegible]-26]

	October discharge	November discharge	December discharge	January discharge	February discharge	March discharge	April discharge	May discharge	June discharge	July discharge	August discharge	September discharge
1	3,400	2,650	3,100			3,100	6,840	29,300	28,000	36,000	8,380	5,200
2	2,580	2,700	3,050		2,620	3,000	6,750	31,200	28,200	30,000	7,500	4,800
3	3,650	2,800	3,050			3,060	6,470	32,700	28,800	24,900	11,000	4,500
4	4,520	2,850	3,000		2,700	4,790	7,330	33,600	28,400	22,200	9,820	4,300
5	4,130	2,950	3,000		2,800	3,940	9,060	33,400	26,800	23,900	10,200	4,090
6	4,110	3,000	3,390		3,000	3,790	10,500	32,300	25,800	20,700	9,360	3,920
7	3,960	3,000	3,500		3,120	3,290	10,600	30,700	26,600	19,500	9,300	5,130
8	3,880	2,950	3,700			3,140	11,000	32,300	28,300	17,600	9,920	4,430
9	3,790	3,000	3,600	2,500		3,240	11,100	33,000	31,200	16,100	10,800	4,700
10	3,770	2,950	3,500		2,900	3,510	10,200	29,900	33,400	13,200	11,500	9,620
11	4,260	2,900	3,200			3,590	9,720	24,100	34,600	16,200	11,500	13,600
12	4,320	3,100	3,000			3,370	9,500	20,600	34,200	17,400	10,500	14,300
13	4,110	3,300	2,700			3,100	8,560	19,800	34,200	16,600	9,360	21,900
14	3,960	3,400	2,600		2,470	2,840	7,300	21,000	34,200	13,900	9,010	17,300
15	3,810	3,300	2,500			2,750	6,920	25,300	34,000	12,600	8,010	14,100
16	3,660	3,200	2,300			2,990	6,300	29,900	36,200	11,400	7,440	11,900
17	3,510	3,100	2,200	2,880		2,990	5,800	34,200	35,400	10,300	7,380	10,500
18	3,360	3,050	2,100		2,800	3,000	5,400	40,500	31,900	9,500	6,920	9,360
19	3,220	3,050				2,830	5,200	47,300	32,500	8,660	5,990	8,220
20	3,200	3,100	2,250	3,100		2,970	6,640	48,400	34,600	8,010	5,360	8,080
21	3,100	3,100			2,930	2,750	7,530	47,300	34,200	7,920	4,000	7,580
22	3,050	3,150				2,610	8,140	45,900	32,100	7,920	4,700	7,300
23	3,010	3,250				2,630	9,070	45,500	29,700	8,500	4,800	7,800
24	2,970	3,300		2,650		2,880	10,500	42,400	27,900	8,750	4,600	8,100

25	[a] 2,930	3,400			3,400	2,930	12,900	37,500	27,400	8,780	4,500	11,300
26	2,850	3,500				2,950	14,800	[b] 34,000	27,900	8,600	5,000	10,200
27	2,770	3,400	2,350			3,200	17,400	33,500	27,600	7,850	5,700	9,560
28	2,700	3,500		2,600	3,100	4,130	20,100	33,400	30,700	7,440	6,800	8,940
29	2,650	3,400				4,720	24,100	32,800	39,100	8,410	6,700	8,320
30	2,620	3,300				5,270	27,700	31,900	42,800	8,910	7,000	7,800
31	2,600			2,650		5,770		29,100		9,070	6,000	
Total	106,410	93,740	85,840	82,380	80,840	105,270	318,580	1,044,100	947,000	442,350	239,080	266,620
Mean	3,430	3,120	2,700	2,660	2,850	3,393	10,700	33,700	31,600	14,200	7,710	8,890
Run-off in acre-feet	211,000	186,000	166,000	164,000	160,000	209,000	625,000	2,070,000	1,880,000	879,000	474,000	529,000
Maximum	4,520	3,500	3,200			5,770	27,700	48,400	42,800	36,000	11,500	21,900
Minimum	2,580	2,630				2,610	5,200	29,100	25,800	7,440	4,000	3,920

COMPLAINANT'S EXHIBIT 94

U. S. Geological Survey Official Gaging Records, Green River, at Greenriver, Utah

[APPENDIX G][1]

GREEN RIVER AT GREEN RIVER [GREENRIVER], UTAH

Location.—In NW. ¼ SW. ¼ Sec. 15, T. 21 S., R. 16 E.; at highway bridge at Greenriver, Emery County. San Rafael River enters from the right 22 miles downstream.

Drainage area.—41,000 square miles (measured on base maps).

Records available.—October, 1894, to September, 1897; March, 1905, to December, 1911, and June, 1924, to September 30, 1927, at present site. From January, 1912, to June, 1924, records were obtained at Little Valley, 7 miles downstream. The flow is practically the same at the two sites. For the earlier years the station was known as "Green River at Elgin or Blake, Utah."

Gage.—Water stage recorder at present site since September, 1924, and at Little Valley site from November, 1914, to June, 1924. Staff and chain gages were used during the remainder of the record.

Discharge measurements.—Made from cable at old ferry site 7 miles below gage in Little Valley.

Channel and control.—Bed composed of gravel and sand. One channel at all stages. Left bank high and not subject to overflow; right bank lower and may be overflowed at extreme stages.

[1] Appendix G to report "Stream Flow Characteristics at Base Gaging Station, Colorado, Green, and San Juan Rivers."

Daily discharge, in second-feet, of Green River, at Elgin, Utah, for the year ending September 30, 1895.

All gage heights have been corrected to the datum of the gage installed June 29, 1895. Revisions for Colorado report, W. S. P. 395. Used rating table dated 1/26/15 by H. J. D.

	October discharge	November discharge	December discharge	January discharge	February discharge	March discharge	April discharge	May discharge	June discharge	July discharge	August discharge	September discharge
1		3,250	2,440	2,100	2,100	2,320	6,200	18,000	21,000	13,900	4,610	2,150
2		3,250	2,440	2,010	2,010	2,380	6,190	19,800	19,500	14,200	4,860	2,150
3		3,250	2,440	2,010	2,010	2,650	6,190	19,800	17,700	14,800	4,740	2,150
4		3,250	2,440	2,010	2,010	2,850	6,060	19,400	17,000	15,000	4,610	2,150
5		3,250	2,440	2,010	2,010	2,900	5,960	18,000	16,000	14,200	4,490	2,080
6		3,100	2,390	2,100	2,100	3,180	4,940	16,700	14,200	12,600	4,370	1,940
7		3,100	2,100	2,100	2,100	3,230	4,940	14,800	14,200	12,000	4,260	1,880
8		3,100	2,100	2,090	2,100	3,250	4,940	14,500	15,100	11,300	4,140	1,880
9		3,100	2,100	2,210	2,210	3,410	4,940	13,900	14,500	10,800	3,920	1,760
10		3,100	2,100	2,100	2,210	3,330	4,940	14,200	14,200	10,800	3,920	1,760
11		3,100	2,210	2,160	2,210	3,250	4,940	13,700	13,900	10,400	3,820	1,650
12		3,100	2,100	2,210	2,210	3,250	4,850	13,800	14,800	10,600	3,610	1,650
13		3,100	2,010	2,100	2,100	3,250	6,720	22,500	16,000	11,100	3,510	1,650
14		3,100	2,100	2,100	2,100	3,250	5,980	25,400	17,900	10,100	4,030	1,550
15		3,100	1,[illegible]	2,100	2,100	3,410	6,290	22,800	16,300	10,100	4,140	1,650
16		3,100	1,[illegible]	2,160	2,100	3,600	6,170	23,300	16,500	10,400	3,510	1,450
17		2,960	1,970	4,210	2,160	3,500	7,070	25,000	15,700	10,100	3,050	1,450
18		2,960	2,010	2,320	2,100	3,500	7,540	25,800	14,800	9,660	2,960	1,600
19		2,960	2,210	2,320	2,160	3,070	8,710	26,300	14,500	8,380	2,880	2,700
20		2,800	2,320	3,440	2,800	2,990	8,710	26,300	14,800	7,580	2,700	1,940
21	3,100	2,820	2,440	2,440	2,100	3,180	8,050	25,400	14,200	6,820	2,700	1,650
22	3,150	2,820	2,440	2,380	2,100	3,410	10,300	25,400	13,900	6,640	2,620	1,550
23	3,180	2,700	2,440	2,220	2,100	4,310	12,300	25,000	13,100	6,300	2,460	1,550
24	3,180	2,600	2,440	2,210	2,100	6,470	13,400	24,500	11,600	6,300	2,300	1,550
25	3,100	2,560	2,320	2,160	2,260	6,470	13,900	25,000	11,000	6,300	2,220	1,450

26												
27	3,100	2,500	2,380	2,160	2,320	5,660	12,800	28,500	11,000	6,140	2,150	1,550
28	3,250	2,440	2,440	2,210	2,320	5,490	12,800	23,700	10,900	5,840	2,300	1,600
29	3,180	2,440	2,380	2,210	2,320	4,720	14,200	22,900	10,500	5,400	2,220	1,650
30	3,180	2,440	2,320	2,160		4,720	15,700	22,900	11,600	5,120	2,150	1,650
31	3,180	2,440	2,210	2,160		4,940	16,700	22,100	13,100	4,860	2,150	1,760
	3,250		2,160	2,160		5,410		21,400		4,740	2,150	
Total	34,880	88,030	69,340	67,220	59,810	117,070	248,280	663,600	438,400	292,480	103,640	53,140
Mean	3,170	2,930	2,240	2,170	2,140	3,780	8,280	21,400	14,600	9,420	3,340	1,770
Run-off in acre-feet	69,200	174,600	138,000	133,000	119,000	232,000	493,000	1,320,000	869,000	580,000	205,000	105,000
Maximum	3,250	3,250	2,440	2,440	2,320	6,470	16,700	28,500	21,000	15,000	4,860	2,790
Minimum	3,100	2,440	1,700	2,010	2,010	2,320	4,720	13,900	10,600	4,740	2,150	1,450

Daily discharge, in second-feet, of Green River at Elgin (Blake), Utah, for the year ending September 30, 1896

Used rating table dated 1/27/15 by H. J. D. Revision for Colorado Report. W. S. P. 395.

[Drainage area, 29,800 square miles]

	October discharge	November discharge	December discharge	January discharge	February discharge	March discharge	April discharge	May discharge	June discharge	July discharge	August discharge	September discharge
1	1,760	1,650	950	1,240	1,450	1,450	4,320	14,500	34,400	11,300	5,650	2,560
2	1,760	1,650	1,000	1,320	1,360	1,450	4,320	14,500	39,300	10,300	5,390	2,400
3	1,760	1,620	1,130	1,400	1,360	1,550	4,110	12,600	43,500	9,430	4,530	2,240
4	1,820	1,820	1,320	1,500	1,360	1,650	4,000	11,400	42,300	8,590	4,070	2,080
5	1,880	1,880	1,360	1,360	1,280	1,600	3,960	10,500	40,400	7,850	3,860	1,870
6	2,010	1,760	1,450	1,360	1,360	1,650	3,510	10,500	38,000	7,520	3,750	1,870
7	2,540	1,650	1,360	1,280	1,400	1,650	3,140	11,600	35,600	7,360	3,550	1,870
8	2,400	1,760	1,360	1,320	1,360	1,650	2,960	13,600	34,400	6,770	3,460	1,800
9	2,300	1,700	1,280	1,360	1,360	1,700	2,960	15,600	32,300	6,480	3,260	1,740
10	2,130	1,650	1,320	1,280	1,470	1,760	2,960	16,800	31,800	6,200	3,170	2,160
11	2,220	1,760	1,360	1,320	1,360	1,760	3,140	17,400	31,800	7,210	3,360	2,080
12	2,540	1,760	1,280	1,360	1,280	1,760	3,320	17,700	28,200	5,520	3,260	2,400
13	2,620	1,760	1,320	1,280	1,280	1,760	3,510	16,800	27,300	5,140	2,900	2,320
14	2,460	1,760	1,360	1,200	1,200	1,880	4,000	15,600	26,800	5,260	2,640	2,160
15	2,380	1,650	1,450	1,160	1,200	2,010	4,110	14,700	27,800	5,650	2,480	2,160
16	2,220	1,550	1,400	1,240	1,280	2,080	4,540	13,800	27,300	5,390	2,320	2,160
17	2,130	1,550	1,450	1,320	1,360	2,130	4,660	11,100	26,400	6,480	2,080	2,320
18	1,940	1,550	1,360	1,400	1,360	2,380	5,010	10,000	25,000	5,390	2,010	2,080
19	1,760	1,550	1,320	1,280	1,450	2,880	4,890	9,050	24,600	5,780	1,870	2,080
20	1,760	1,550	1,450	1,320	1,450	3,420	5,140	8,350	22,900	6,770	1,870	3,460
21	1,760	1,650	1,450	1,360	1,550	3,320	5,520	7,830	22,500	7,210	2,080	5,780
22	1,940	1,650	1,450	1,400	1,550	2,700	6,540	7,330	21,300	6,480	2,400	2,640
23	2,460	1,760	1,360	1,400	1,550	2,620	5,520	7,330	20,900	6,060	2,720	9,430
24	1,880	1,760	1,280	1,360	1,450	2,780	4,770	7,330	20,100	5,780	2,990	6,620
25	1,820	1,550	1,320	1,280	1,450	2,880	4,320	7,830	19,800	5,650	2,900	4,650

1560

26	1,760	1,450	1,360	1,280	1,360	3,230	4,660	9,640	18,300	6,200	3,170	5,260
27	1,760	1,240	1,280	1,280	1,400	3,600	5,520	11,600	16,600	6,200	3,360	3,960
28	1,760	1,030	1,200	1,360	1,450	3,990	8,350	16,200	14,500	6,340	3,860	3,460
29	1,760	975	1,130	1,360	1,450	4,220	11,100	21,600	13,400	6,200	5,020	3,260
30	1,700	900	1,130	1,450		4,540	13,100	26,100	12,300	5,920	3,460	2,990
31	1,650		1,160	1,450		4,320		29,800		5,920	2,900	
Total	62,740	47,575	40,440	41,280	40,270	76,310	147,900	418,010	822,000	208,350	100,340	91,860
Mean	2,020	1,590	1,300	1,330	1,390	2,460	4,930	13,500	27,400	6,720	3,240	3,060
Run-off in acre-feet	124,000	94,600	79,900	81,800	80,000	151,000	293,000	830,000	1,630,000	413,000	199,000	182,000
Maximum	2,630	1,880	1,450	1,740	1,550	4,540	13,100	29,800	43,500	11,300	5,650	9,430
Minimum	1,650	900	950	1,160	1,200	1,450	2,960	7,330	12,300	5,140	1,870	1,740
Accuracy												

Daily discharge, in second-feet, of Green River at Elgin (Blake), Utah, for the year ending September 30, 1897

[Drainage area, 23,800 square miles]

Unit rating table dated 1/27/13 by H. J. D. Revisions for Colorado Report W. S. P., 395

Day	October discharge	November discharge	December discharge	January discharge	February discharge	March discharge	April discharge	May discharge	June discharge	July discharge	August discharge	September discharge
1	2,810	1,940					4,100	15,700	55,200	10,500	3,700	2,010
2	2,960	1,870		980			4,000	17,600	51,200	9,640	3,700	1,880
3	2,720	1,870					3,960	20,100	50,500	8,880	3,510	1,880
4	2,640	1,870					3,960	23,300	47,900	8,880	3,320	2,080
5	2,640	1,740					3,750	27,300	47,900	9,260	3,510	1,880
6	2,480	1,740			1,080	1,280	4,070	31,800	47,200	9,070	3,700	2,080
7	2,400	1,740					3,860	33,900	37,600	8,350	3,900	2,150
8	2,160	1,740	1,180				3,550	35,600	31,800	8,000	4,110	2,380
9	2,160	1,680		980			3,550	38,000	27,900	7,660	4,110	2,620
10	2,160	1,620					3,750	40,400	25,200	7,330	3,900	2,880
11	2,160	1,560					3,960	43,000	22,800	7,010	3,900	3,600
12	2,010	1,500					3,650	46,200	22,000	6,700	3,900	7,330
13	2,010	1,500			1,180		3,650	46,800	24,400	6,390	4,000	7,330
14	2,010	1,500					3,960	45,600	23,600	6,090	4,110	9,450
15	2,010	1,440				1,280	4,530	38,600	24,400	5,800	4,110	4,540
16	2,010	1,380	1,380	1,080			5,620	36,800	23,600	5,520	3,900	3,900
17	2,010	1,800					5,520	39,200	22,800	5,520	3,700	3,700
18	1,940	1,620					5,920	41,600	22,000	5,520	3,420	2,960
19	1,870	1,740					6,200	44,200	20,900	5,260	3,230	2,790
20	1,870	1,870			1,180	1,380	6,200	46,800	20,100	5,260	2,960	2,790
21	1,870	1,740					6,620	48,200	19,100	5,010	2,880	2,620
22	1,870	1,620					9,650	48,200	18,100	5,010	2,620	2,460
23	1,870	1,740	1,180	980			9,000	48,200	16,800	4,770	2,620	2,300
24	1,800	1,870					12,300	50,800	15,600	4,770	2,460	2,300

25	1,740	2,010					13,100	55,700	14,500	4,770	2,460	2,300
26	1,740	2,160					10,600	61,300	13,900	4,540	2,300	2,300
27	1,740	2,060			1,250	4,480	10,100	65,000	13,400	4,320	2,300	2,540
28	1,940	1,800					10,100	62,000	14,500	4,100	2,150	2,880
29	1,740	1,700				4,410	11,300	67,300	12,300	4,110	2,150	3,230
30	1,940	1,600	1,080	890			13,100	63,600	11,400	4,110	2,450	3,800
31	2,060							60,600		3,900	2,150	
Total	65,350	5,750	(40,300)	(21,000)	(33,600)	(62,000)	193,030	1,347,400	393,600	198,000	100,960	96,960
Mean	2,110	1,720	(1,300)	(1,000)	(1,250)	(2,000)	6,430	43,500	26,600	6,320	3,260	3,230
Run-off in acre-feet	130,000	102,000	79,900	41,500	66,700	123,000	383,000	2,670,000	1,680,000	389,000	200,000	192,000
Maximum	2,950	2,160					13,100	67,300	55,200	10,500	4,110	9,450
Minimum	1,740	1,390					3,550	15,700	11,400	3,900	2,150	1,880
Accuracy												

Daily discharge, in second-feet, of Green River at Greenriver, Utah, for 1905

[Drainage area, 38,200 square miles]

(Recomputations)

Day	January discharge	February discharge	March discharge	April discharge	May discharge	June discharge	July discharge	August discharge	September discharge	October discharge	November discharge	December discharge
1			1,760	2,900	6,360	22,500	13,400	3,840	1,870	6,190	1,990	1,870
2			1,870	3,180	6,870	21,400	12,900	3,720	1,870	4,180	2,060	1,760
3			1,870	3,280	8,920	22,800	12,400	3,720	1,870	3,500	1,930	1,550
4			2,050	2,900	10,100	24,500	12,100	3,720	1,870	3,390	1,820	1,370
5			2,120	2,720	11,600	27,000	11,800	3,720	2,060	2,990	2,060	1,370
6			2,120	2,720	12,400	28,400	11,300	3,720	2,060	2,900	2,190	1,290
7			2,340	2,720	12,100	28,800	10,800	3,500	3,080	2,640	2,120	1,290
8			2,720	2,720	10,800	30,200	10,300	3,280	2,640	2,560	2,120	1,220
9			2,900	2,900	9,380	32,000	9,850	3,080	2,480	2,340	2,260	1,220
10			3,500	2,720	8,920	33,900	9,380	3,080	2,640	2,410	2,120	1,220
11			3,840	2,720	8,040	33,500	8,920	2,900	2,810	2,560	1,990	1,290
12			3,720	2,810	8,040	30,200	8,260	2,810	2,810	2,410	1,930	1,330
13			3,360	3,180	8,920	31,300	7,630	2,720	2,480	2,260	1,870	1,370
14			3,180	3,720	10,600	31,300	7,440	2,720	2,340	2,340	1,820	1,370
15			3,080	4,060	9,620	29,500	6,700	2,720	2,060	2,120	1,990	1,370
16			3,080	4,700	8,700	28,800	6,520	2,720	1,990	2,120	1,990	1,290
17			3,080	4,430	8,040	24,200	6,360	2,640	1,870	2,120	1,990	1,370
18			3,080	4,430	8,040	24,500	6,030	2,480	1,990	2,120	1,990	1,370
19			3,080	5,400	8,040	23,800	5,870	2,260	2,120	1,990	1,870	1,370
20			3,280	5,400	8,920	23,100	5,710	2,260	1,990	1,870	1,870	1,370
21			3,180	4,840	10,800	21,800	5,550	2,260	2,190	1,870	1,990	
22			3,610	4,700	13,700	20,400	5,550	2,260	2,260	1,990	2,560	
23			3,720	4,970	16,000	19,700	5,250	[illegible]	2,410	2,060	2,340	
24			3,500	5,110	18,100	18,800	5,250	[illegible]	2,260	1,990	2,260	
25			3,280	5,400	20,100	18,400	4,970	1,990	2,560	1,990	2,120	

26			3,280	5,400	21,800	17,200	4,840	2,190	2,640	1,990	1,990	
27			3,280	4,970	23,100	16,600	4,700	2,190	2,900	1,990	2,060	
28			3,280	5,110	24,200	15,400	4,430	1,990	2,990	1,990	2,190	
29			3,280	5,710	23,100	14,800	4,300	1,990	4,060	1,990	2,120	
30			3,080	6,360	23,100	14,000	4,180	1,930	6,030	1,990	1,990	
31			3,080		22,800		4,180	1,870		1,990		
Total			92,630	122,180	401,210	728,800	236,870	84,530	75,200	76,850	61,000	40,860
Mean			2,990	4,070	12,900	24,300	7,640	2,730	2,510	2,480	2,050	1,320
Sec.-ft. per square mile			.078	.106	.338	.636	.200	.071	.066	.065	.054	.035
Run-off, depth in inches			.09	.12	.39	.71	.23	.08	.07	.07	.06	.04
Run-off in acre-feet			184,000	242,000	793,000	1,450,000	470,000	168,000	149,000	152,000	122,000	81,200
Maximum			3,840	6,360	24,200	33,900	13,400	3,840	6,030	6,190	2,560	1,870
Minimum			1,760	2,720	6,360	14,000	4,180	1,870	1,870	1,870	1,820	
Accuracy			A	A	A	B	A	A	A	A	A	C

Daily discharge in second-feet of Green River, Greenriver, Utah, for 1906

[Drainage area 38,200 square miles]

[Recomputations]

Day	January discharge	February discharge	March discharge	April discharge	May discharge	June discharge	July discharge	August discharge	September discharge	October discharge	November discharge	December discharge
1	Mean for month estimated as 1,400	Estimated 150	1,870	12,100	14,200	33,100	14,200	7,840	6,700	3,720	3,080	1,700
2			1,870	11,600	13,400	35,400	14,800	8,260	7,440	3,500	5,870	1,820
3			1,870	9,380	13,100	36,800	15,400	7,840	6,870	3,500	4,700	2,120
4			2,190	8,470	12,600	39,100	15,700	8,040	6,360	3,500	4,970	2,990
5			2,260	8,040	12,600	40,400	15,700	7,240	6,360	3,500	4,970	3,280
6			2,340	7,630	12,400	41,000	15,700	7,060	6,520	3,280	4,560	3,080
7			2,410	7,060	12,100	40,200	15,700	6,870	6,520	3,280	4,060	3,080
8			2,480	5,550	13,400	41,000	15,700	6,520	6,030	3,180	3,720	3,280
9			2,640	5,550	13,700	42,100	15,100	6,190	5,550	3,080	3,720	2,810
10			2,640	5,400	14,000	42,100	15,100	6,030	5,250	3,080	3,720	2,560
11		1,600	2,640	6,030	17,800	39,900	15,700	5,710	5,110	3,080	3,720	2,410
12		1,550	3,180	7,060	20,100	38,300	15,700	5,250	4,700	3,080	3,610	2,640
13		1,500	3,620	6,870	21,700	30,200	15,400	5,250	4,430	3,080	3,500	2,560
14		1,500	5,250	6,870	25,200	27,700	15,100	5,250	4,180	2,900	3,500	2,410
15		1,600	5,550	7,210	30,200	26,300	15,100	5,400	4,060	2,900	3,280	2,560
16		1,600	5,400	8,700	32,600	25,200	14,800	4,970	4,540	2,900	3,280	2,480
17		1,580	4,970	8,470	31,300	24,700	14,500	4,970	4,300	2,900	3,280	2,260
18		1,550	4,430	8,260	30,200	25,000	14,200	4,840	4,700	2,900	3,180	2,120
19		1,700	4,180	8,470	31,300	25,000	14,000	4,430	5,250	2,720	3,080	1,990
20		1,700	3,720	8,700	30,600	25,200	14,200	4,430	4,540	2,720	2,810	1,820
21		1,820	2,990	8,260	31,000	26,500	13,700	4,700	4,540	2,720	2,480	1,700
22		1,820	3,280	9,850	31,700	25,900	12,900	5,570	5,400	2,900	2,260	1,820
23		1,820	4,060	10,600	32,400	24,900	12,100	6,700	4,700	2,900	1,870	1,820
24		1,820	4,970	12,600	33,100	25,600	10,800	7,440	4,430	2,900	1,760	1,820

25		1,820	6,030	13,100	33,100	25,900	10,300	6,360	4,430	2,900	1,870	2,190
26		1,820	9,620	14,000	32,100	26,700	10,300	5,870	4,180	2,900	2,260	2,560
27		1,820	14,800	13,700	32,400	27,400	9,620	5,710	3,950	2,810	2,410	2,560
28		1,760	21,800	14,600	33,100	25,900	9,380	6,360	3,840	2,720	2,340	2,560
29			20,400	16,100	34,200	24,500	8,920	6,520	3,720	2,560	2,060	2,720
30			18,800	15,400	34,400	25,600	8,200	7,060	3,720	2,720	1,820	2,640
31			16,600		36,500		8,040	6,700		2,900		2,900
Total		45,260	189,300	287,350	768,100	940,200	416,420	191,360	152,380	93,730	97,740	75,320
Mean	1,400	1,620	6,110	9,580	24,800	31,300	13,400	6,170	5,080	3,020	3,260	2,430
Sec.-ft. per square mile	.039	.042	.160	.251	.649	.819	.351	.162	.133	.079	.085	.064
Run-off, depth in inches	.04	.04	.18	.28	.75	.91	.40	.19	.15	.09	.09	.07
Run-off in acre-feet	86,400	96,000	376,000	570,000	1,520,000	1,860,000	824,000	379,000	302,000	186,000	194,000	149,000
Maximum			21,800	16,900	36,500	42,100	15,700	8,260	7,440	3,720	5,870	3,280
Minimum			1,870	5,400	12,400	24,500	8,040	4,430	3,720	2,560	1,760	1,700
Accuracy	D	C	B	A	A	A	A	A	A	A	A	B

Daily discharge in second-feet of Green River at Greenriver, Utah, for 1907

[Drainage area 30,200 square miles. Revised for W. S. P. 200]

Recomputation

Day	January discharge	February discharge	March discharge	April discharge	May discharge	June discharge	July discharge	August discharge	September discharge	October discharge	November discharge	December discharge
1	3,400	3,730	6,040	6,200	13,100	31,000	30,400	15,200	6,900	3,450	3,000	1,900
2	3,610	3,640	7,640	6,700	13,700	30,200	30,400	16,100	6,900	3,110	3,000	1,740
3	3,720	3,500	7,640	7,560	14,000	29,900	30,100	17,100	6,900	3,000	3,000	1,800
4	3,640	3,500	6,700	7,900	14,000	29,900	30,200	19,300	6,900	3,220	3,000	1,820
5	3,500	3,730	6,020	6,970	14,000	33,000	30,000	14,200	7,560	3,100	3,000	1,740
6	3,500	3,600	5,130	6,100	14,100	30,000	41,400	13,200	6,900	3,920	3,000	1,740
7	3,540	3,590	5,110	6,100	14,900	40,700	43,100	14,000	6,110	3,940	3,000	1,600
8	3,130	3,730	5,200	7,300	14,200	43,500	43,900	14,000	6,120	3,900	3,000	1,600
9	3,540	4,300	6,640	6,700	14,000	44,000	43,900	14,000	6,120	3,900	3,000	1,600
10	3,500	3,250	6,100	6,100	13,100	40,000	43,100	13,400	5,700	3,100	3,700	1,600
11	3,500	4,070	6,100	10,100	13,100	40,100	43,100	13,200	4,620	4,070	3,700	1,670
12	3,500	7,640	6,300	10,000	13,200	47,700	41,600	11,900	5,100	4,400	3,700	1,670
13	3,610	4,670	6,630	10,300	13,700	40,000	40,300	10,100	4,700	4,700	3,700	1,670
14	3,610	3,670	6,630	10,000	27,100	44,000	30,100	11,100	4,620	3,200	3,700	1,670
15	3,610	3,250	6,100	14,000	31,000	43,000	30,000	10,000	4,400	3,200	3,700	1,670
16	3,500	4,070	6,100	10,000	34,000	40,700	30,900	10,000	4,400	4,620	3,700	1,550
17	3,500	3,110	6,100	10,400	34,000	30,000	31,000	9,700	4,360	4,070	3,700	1,550
18	3,600	4,700	5,000	21,000	29,000	30,000	30,200	9,000	4,200	3,000	3,500	1,550
19	3,610	4,700	5,720	22,000	22,000	27,700	27,700	9,000	3,620	3,000	3,400	1,550
20	3,540	4,700	5,720	22,000	22,000	27,700	27,300	8,500	3,600	3,450	3,400	1,550
21	3,600	4,700	5,720	24,100	20,700	24,100	25,000	7,960	3,600	3,240	3,400	1,540
22	3,640	3,710	6,130	24,100	20,000	27,700	22,000	7,720	3,450	3,220	3,220	1,540
23	3,500	6,000	6,100	20,100	24,000	27,700	22,000	7,500	3,450	3,220	3,220	1,540
24	3,130	6,130	7,340	17,100	20,400	27,000	20,000	7,100	3,450	3,220	3,220	1,540
25	1,000	5,400	13,400	10,000	41,000	19,000	20,000	7,000	3,220	3,220	3,000	1,540

26	1,630	3,670	13,400	16,000	43,300	30,300	20,300	7,310	3,220	3,220	2,090	1,360
27	2,080	8,030	13,400	13,100	41,600	37,000	20,300	5,300	3,220	3,220	1,800	1,350
28	2,200	7,640	12,800	13,100	43,900	37,300	20,300	8,000	3,220	3,220	1,800	1,350
29	2,600		12,100	13,100	45,700	36,400	19,700	9,100	3,220	3,000	1,800	1,350
30	2,360		11,100	13,100	37,000	36,400	19,700	7,720	3,220	3,000	1,800	1,350
31	2,720		10,100		29,600		16,000	7,300		3,000		1,350
Total	73,940	137,630	300,610	419,300	794,600	1,151,100	960,400	247,600	144,650	113,610	73,940	45,310
Mean	2,640	4,610	8,790	14,000	24,700	28,800	31,000	11,200	4,620	3,670	2,500	1,470
Sec.-ft. per square mile	084	130	177	300	647	1.02	629	292	123	096	067	039
Run-off, depth in inches	57	13	20	41	71	1.19	92	34	14	11	07	04
Run-off in acre-feet	130,000	273,000	418,000	633,000	1,520,000	2,310,000	1,940,000	660,000	287,000	228,000	152,000	90,400
Maximum	2,900	7,640	13,400	26,000	43,900	46,100	43,900	19,300	7,940	3,260	2,000	1,800
Minimum	1,630	2,360	3,720	8,000	13,100	26,600	13,000	7,100	3,220	3,000	1,800	1,240
Accuracy	B	A	A	A	D	D	D	A	A	A	D	C

Daily discharge in second-feet of Green River at Greenriver, Utah for 1918

[Drainage area 30,270 square miles. Revised by W. S. P. 309]

[Rating tabulations: Jan. estimate at 1,300 sec.-ft., 1,710; 1,40 sec.-ft., 1,800; 11 to 22 sec.-ft. at 1,500 sec.-ft.]

Day	January discharge	February discharge	March discharge	April discharge	May discharge	June discharge	July discharge	August discharge	September discharge	October discharge	November discharge	December discharge
1			1,700	6,200	9,000	14,000	14,600	5,730	5,000	6,120	3,220	2,0
2			1,740	5,940	9,000	13,800	13,800	6,310	4,920	5,000	3,220	2,0
3			1,800	5,610	8,160	13,650	13,800	5,340	4,920	4,680	2,950	2,0
4			1,830	5,670	9,120	11,300	12,900	5,220	4,680	4,150	2,950	2,0
5			2,400	5,670	9,180	11,400	12,900	4,800	4,320	3,820	2,950	2,0
6			2,300	5,430	8,820	12,600	12,800	7,780	4,150	3,660	2,700	2,0
7			2,300	5,430	8,280	13,400	13,300	5,340	3,660	3,510	2,700	2,0
8			2,300	5,430	9,300	14,000	13,300	5,000	5,080	3,220	2,470	
9			2,300	5,430	9,540	13,600	12,800	4,920	4,920	3,220	2,470	
10			2,700	5,430	10,200	14,400	12,800	5,000	2,700	2,950	2,280	
11			2,700	5,430	10,800	15,600	12,800	4,710	2,470	2,800	2,280	
12			2,700	5,640	11,700	16,500	12,600	4,920	2,470	2,800	2,280	
13			2,700	5,650	13,700	16,200	12,200	5,300	2,280	2,800	2,280	
14			3,000	5,820	14,300	16,700	12,300	4,920	2,280	2,950	2,280	
15			3,300	6,360	14,600	20,200	11,000	5,300	2,280	2,700	2,070	
16			3,670	6,030	14,500	22,300	10,800	5,300	2,070	2,700	1,890	
17			4,530	6,630	12,200	23,500	10,800	5,300	2,070	2,700	1,890	
18			4,780	7,940	11,700	24,300	10,300	5,300	2,070	2,580	1,750	
19			4,200	8,700	11,100	24,300	9,620	5,130	2,070	2,820	1,750	
20			3,960	7,500	11,100	23,100	8,500	4,920	1,890	4,650	1,900	
21			4,340	9,930	11,700	23,400	8,000	5,300	2,070	4,650	1,650	
22			5,100	10,200	12,300	22,800	8,440	5,300	5,170	4,170	1,650	
23		1,700	5,940	11,400	13,100	21,900	8,000	5,300	3,820	3,820	1,600	
24		1,700	5,430	12,300	13,400	22,400	8,000	5,300	3,510	3,510	1,400	
25		1,700	5,100	12,900	14,300	21,400	7,500	6,600	4,820	3,510	1,900	

Estimated at 800 sec.-ft. by R. C. B. and A. H. B.

1570

26		1,800	5,100	12,800	12,800	20,800	6,510	6,710	4,180	3,510	1,900	
27		1,800	4,780	11,900	12,500	19,200	6,120	6,710	3,220	3,510	2,070	
28		1,740	4,340	11,400	13,700	18,600	5,540	6,510	2,680	3,220	2,070	
29		1,740	4,070	10,800	14,300	17,100	4,820	6,310	3,820	3,220	1,900	
30			3,940	9,800	14,000	16,200	5,730	5,920	5,300	3,220	830	
31			3,940		14,000		4,820	5,360		3,220		
Total	40,300	44,480	110,760	197,690	360,860	512,000	318,000	211,230	101,440	111,120	64,770	24,845
Mean	1,300	1,530	3,570	6,590	11,600	18,100	10,300	6,810	3,380	3,580	2,160	801
Sec.-ft. per square mile	.034	.040	.093	.172	.304	.474	.270	.179	.088	.094	.057	.021
Run-off, depth in inches	.04	.05	.11	.19	.35	.53	.31	.21	.10	.11	.06	.02
Run-off in acre-feet	79,900	88,000	220,000	392,000	713,000	1,080,000	633,000	419,000	201,000	220,000	129,000	49,300
Maximum			5,940	12,800	14,000	25,000	14,400	8,890	5,300	6,120	3,220	1,460
Minimum			1,740	3,450	8,160	11,400	4,820	4,820	1,900	2,700	830	750
Accuracy	C	C	A	A	A	A	A	A	B	B	B	C

Daily discharge, in second-feet, of Green River at Greenriver, Utah, for 1909

Day	January discharge	February discharge	March discharge	April discharge	May discharge	June discharge	July discharge	August discharge	September discharge	October discharge	November discharge	December discharge
1	930	2,580	1,600	10,300	12,300	33,400	42,600	12,500	17,400	4,820	3,220	4,820
2	1,100	2,260	1,460	9,580	14,400	34,800	40,800	12,000	18,000	4,820	3,080	3,980
3	1,210	2,260	1,600	8,890	14,700	34,100	40,100	11,000	15,300	4,820	2,950	3,360
4	1,210	1,900	1,750	8,000	14,200	33,000	39,400	10,800	11,800	4,650	3,080	2,950
5	1,210	1,750	2,260	7,780	13,100	32,700	38,300	10,800	11,000	4,480	3,220	2,070
6	1,210	1,750	2,070	7,130	11,000	33,200	37,200	9,830	12,000	4,480	3,220	1,530
7	1,460	1,600	2,360	9,350	11,300	39,400	37,600	9,350	13,900	4,480	3,220	1,270
8	1,600	1,460	2,820	12,800	13,100	42,600	36,600	9,350	12,800	4,150	3,220	1,160
9	1,750	1,460	3,360	13,300	15,600	45,200	36,600	9,580	11,800	4,150	3,220	1,060
10	1,900	1,330	3,820	11,000	19,500	51,100	36,200	9,350	10,800	4,150	3,220	930
11	1,900	1,330	4,150	8,440	21,200	55,900	34,100	8,890	10,800	3,980	3,220	895
12	2,070	1,460	4,480	8,000	22,100	59,600	31,000	8,440	12,000	3,980	3,220	
13	2,070	1,460	4,150	7,130	25,400	62,300	29,600	8,440	12,800	3,510	3,220	
14	2,260	1,330	4,480	5,390	24,800	60,400	24,800	8,000	12,300	3,820	3,080	
15	2,260	1,460	5,000	4,820	26,400	55,600	22,800	8,000	10,800	3,980	2,950	
16	2,070	1,600	4,480	5,170	24,800	52,300	21,500	11,500	9,580	4,150	2,950	
17	1,750	1,750	3,980	5,730	24,100	48,300	20,200	14,100	9,120	4,150	2,950	
18	1,750	1,750	3,510	6,120	23,100	44,800	18,600	13,100	8,660	4,480	2,700	
19	1,900	1,600	3,980	7,780	22,400	43,700	18,000	12,800	8,000	4,320	2,700	
20	1,900	1,600	4,320	10,100	23,100	45,200	17,700	12,800	8,000	3,820	2,580	
21	1,820	1,750	6,920	13,100	23,100	46,300	16,500	11,500	7,500	3,660	2,470	
22	1,900	1,900	11,300	16,200	24,100	47,800	14,700	12,300	7,130	3,510	2,470	
23	1,900	2,070	19,200	14,400	25,500	47,400	15,000	11,800	6,310	3,220	2,700	
24	2,360	1,900	33,000	12,800	27,300	48,700	15,900	10,800	6,310	3,220	2,820	
25	2,470	1,750	23,800	11,000	29,200	50,400	14,700	9,580	6,310	3,360	2,950	
26	1,980	1,600	19,900	9,580	30,200	50,000	14,400	9,120	5,920	3,510	2,700	
27	2,360	1,600	17,700	8,000	32,700	50,000	13,400	8,890	5,920	3,360	2,700	
28	2,950	1,530	15,900	9,580	32,400	49,000	13,000	8,440	5,540	3,220	2,950	

— Ice conditions Dec. 12-31.
— Estimated discharge 300 sec.-ft.

1572

29	3,360		14,700	9,120	29,600	45,400	13,300	8,000	5,360	3,220	2,950	
30	3,510		12,500	8,000	30,700	44,400	13,300	8,660	5,170	3,220	3,510	
31	3,220		11,300		31,300		12,800	9,820		3,220		
Total	61,340	48,070	251,850	278,160	694,700	1,389,300	782,100	318,330	298,790	121,910	80,440	40,005
Mean	1,980	1,720	8,120	9,290	22,400	46,300	25,200	10,300	9,990	3,930	2,980	1,250
Sec.-ft. per square mile	.052	.045	.213	.243	.588	1.21	.660	.270	.262	.103	.078	.34
Run-off depth, in inches	.06	.05	.25	.27	.68	1.35	.76	.31	.29	.12	.09	.04
Run-off, in acre-feet	122,000	95,300	499,600	553,000	1,380,000	2,760,000	1,550,000	633,000	593,000	242,000	177,000	79,300
Maximum	3,510	2,380	33,000	16,200	32,700	62,200	42,600	14,100	18,900	4,820	3,510	4,820
Minimum	930	1,330	1,460	4,820	14,000	32,700	12,800	8,000	5,170	3,220	2,470	895
Accuracy	B	B	B	A	A	C	A	A	A	A	A	C

Daily discharge, in second-feet, of Green River near Greenriver, Utah, for 1910

[Drainage area, 30,200 square miles]

Day	January discharge	February discharge	March discharge	April discharge	May discharge	June discharge	July discharge	August discharge	September discharge	October discharge	November discharge	December discharge
1	Estimated at 1,000 sec. feet per day	1,200	2,700	11,000	24,800	19,800	6,500	4,050	1,100	1,300	3,000	2,000
2		1,200	3,600	9,380	27,500	21,000	6,120	4,050	1,100	1,640	2,800	2,000
3		1,200	4,320	9,350	26,800	21,300	5,200	4,050	6,500	2,000	2,720	2,000
4		1,200	4,920	9,800	26,100	20,700	5,100	3,750	2,720	2,000	2,560	2,000
5		1,200	6,580	7,780	24,800	20,100	4,800	3,300	1,350	2,220	2,540	2,000
6		1,200	10,900	8,000	21,800	20,100	4,800	3,300	1,300	2,460	2,220	1,800
7		1,200	13,700	9,000	21,200	20,700	4,800	3,300	1,300	2,460	2,220	1,800
8		1,200	16,000	9,000	19,500	20,700	4,300	3,450	1,300	2,460	2,220	1,800
9		1,200	19,300	9,000	19,500	19,200	4,200	3,000	1,300	2,460	2,000	1,800
10		1,200	22,400	9,000	19,600	19,000	4,200	3,000	1,300	2,460	2,000	1,800
11		1,200	19,300	9,000	20,200	16,500	3,000	2,540	1,300	2,220	2,000	1,800
12		1,300	16,200	7,500	21,500	15,900	3,300	2,110	1,350	2,220	2,000	1,800
13		1,300	14,200	8,500	22,400	14,700	3,000	1,800	1,400	2,460	2,000	1,800
14		2,000	12,300	9,100	21,800	13,200	2,720	1,640	1,400	2,460	2,500	1,800
15		2,300	11,900	11,300	20,500	12,800	2,460	1,640	1,640	2,460	3,450	1,800
16		3,000	10,300	12,300	20,800	11,800	2,460	1,640	1,640	2,720	3,300	1,800
17		3,300	10,100	13,200	20,100	10,200	2,460	1,500	2,220	5,940	2,590	1,800
18		4,000	9,350	14,700	21,000	11,000	2,460	1,500	3,450	5,420	2,110	1,800
19		4,300	9,800	12,100	24,300	11,000	2,000	1,500	2,720	5,100	2,000	1,720
20		4,320	9,350	13,300	22,600	10,500	2,460	1,500	2,860	4,800	2,000	1,570
21		3,000	9,350	12,800	18,800	10,500	2,460	1,400	2,860	4,100	2,000	1,300
22		3,300	9,350	12,800	17,700	10,000	2,220	1,300	2,590	5,100	2,000	1,150
23		2,220	10,200	14,400	17,100	9,540	2,000	1,400	2,540	4,500	2,000	810
24		2,700	11,300	15,000	17,100	9,080	1,800	1,300	2,220	4,350	2,000	810
25		2,700	11,800	16,500	16,600	8,400	1,800	1,300	2,220	4,200	2,000	770
26		2,700	11,800	18,600	16,500	7,740	1,640	1,300	2,220	4,050	2,000	930

27		3,000	12,300	20,800	15,000	6,900	1,640	1,300	2,220	3,780	2,000	930
28		3,000	12,300	19,900	15,300	6,500	1,640	1,200	2,000	3,450	2,000	900
29			12,800	21,500	13,800	6,310	2,000	1,200	1,800	3,300	2,000	900
30			12,800	24,800	13,000	6,700	2,220	1,200	1,350	3,300	2,000	900
31			12,300		13,900		3,450	1,100		3,300		900
Total	31,000	70,030	354,470	375,700	658,200	469,770	100,070	66,910	61,070	101,510	68,210	46,900
Mean	1,000	2,500	11,400	12,100	21,200	15,700	3,230	2,160	2,040	3,280	2,270	1,520
Second-feet per square mile	.026	.065	.298	.327	.555	.359	.085	.056	.053	.086	.059	.040
Run-off, depth in inches	.03	.07	.34	.36	.64	.40	.10	.06	.05	.10	.07	.05
Run-off in acre-feet	61,500	139,000	701,000	744,000	1,300,000	815,000	199,000	133,000	121,000	202,000	135,000	93,500
Maximum		7,500	22,400	24,800	28,800	21,500	6,500	4,650	4,500	5,940	3,450	2,000
Minimum		1,200	2,700	7,500	13,000	6,310	1,640	1,100	1,100	1,300	2,000	770
Accuracy	D	D	C	A	B	C	B	B	B	B	B	B

NOTE.—Jan., est. at 1000—— ft. Feb. 1-20, est. March 7-8-9 interpolated. River frozen solid from bank to bank—Jan. 1 to Feb. 5. Feb. 6-12. Frozen under gage. Feb. 13. River partly open. Feb. 17. River open. Mar. 7-8-9. Ice flow all day. Mar. 1 to Jan. K mile above gage. Mar. 2 to Jan. K one out. Dec. 22-1 26——ice. Dec. 27. Frozen under gage.

Daily discharge, in second-feet, of Green River, at Elgin, Utah, for 1911

[Drainage area, 38,209 square miles]

Day	January discharge	February discharge	March discharge	April discharge	May discharge	June discharge	July discharge	August discharge	September discharge	October discharge	November discharge	December discharge
1		4,600	1,500	5,390	7,770	11,320	16,400	4,480	2,040	3,950	2,570	1,910
2		5,510	1,630	5,045	9,380	12,820	14,240	4,460	2,080	4,180	2,570	1,910
3		8,460	2,100	4,820	10,140	13,500	13,520	4,350	1,940	4,740	2,570	1,850
4		8,640	2,260	4,710	10,140	13,600	12,610	4,230	1,970	5,160	2,570	1,780
5		7,600	2,580	5,045	9,950	13,960	11,950	4,010	2,010	5,000	2,570	1,730
6		6,280	2,790	5,360	8,820	15,630	10,515	3,790	2,100	5,630	2,570	1,700
7		4,820	2,940	6,280	8,640	15,880	11,085	3,560	2,090	6,110	2,430	1,590
8		4,380	3,290	7,130	9,600	15,880	10,600	3,480	1,980	6,120	2,420	1,640
9		4,050	5,160	7,440	9,950	17,160	10,050	3,270	1,910	5,890	2,360	1,640
10		3,470	5,160	7,280	11,120	17,420	9,670	3,070	1,760	5,450	2,320	1,720
11		2,940	9,380	6,835	14,420	18,230	9,490	2,990	1,750	5,050	2,280	1,700
12		2,720	12,600	6,280	14,420	19,050	9,310	2,950	1,680	4,770	2,160	1,690
13		2,580	13,500	5,890	16,130	19,050	8,790	2,790	1,670	4,050	2,160	1,680
14		2,510	12,160	5,390	15,630	19,050	8,620	2,780	1,640	3,840	2,000	1,670
15		2,445	10,330	5,390	14,190	18,775	8,455	2,750	1,700	3,520	2,050	1,660
16		2,380	8,110	5,390	13,270	18,500	7,810	2,600	1,750	3,440	2,000	1,650
17	2,650	2,320	6,835	5,045	12,820	18,500	7,650	2,590	1,690	3,430	1,970	1,640
18	2,720	2,260	6,410	4,930	12,600	18,500	7,340	2,440	1,690	3,290	1,950	1,640
19	3,025	2,150	6,150	4,490	12,600	20,990	6,880	2,430	1,680	3,130	1,940	1,630
20	3,290	2,050	6,150	4,490	14,190	23,050	6,315	2,300	1,588	2,940	1,940	1,630
21	3,290	1,950	6,150	4,050	13,960	27,600	6,050	2,310	1,570	2,700	2,080	1,630
22	3,110	1,905	6,150	4,050	13,960	26,950	5,920	2,300	1,560	2,690	2,160	1,630
23	2,940	1,860	6,150	4,050	13,500	26,950	5,670	2,400	1,550	2,630	2,590	1,630
24	2,720	1,780	7,130	4,050	11,950	25,975	5,795	2,520	1,540	2,570	2,640	1,560
25	2,510	1,780	7,440	4,490	10,140	25,650	5,670	2,390	1,530	2,570	2,590	1,560
26	2,260	1,665	7,600	4,710	10,140	24,040	5,670	2,380	1,520	2,440	2,250	1,500

1,200

2,600

27	2,260	1,630	7,280	5,760	10,140	23,405	5,420	2,260	2,240	2,440	2,060	1,500
28	2,260	1,630	6,980	6,280	10,520	22,470	5,420	2,250	3,370	2,440	1,900	1,500
29	3,200		6,550	6,835	11,120	19,550	5,180	2,150	3,310	2,570	1,740	1,450
30	4,380		6,150	7,130	11,530	18,190	5,065	2,140	4,390	2,570	1,860	1,450
31	4,050		6,150		11,740		4,950	2,130		2,570		1,450
Total	72,265	96,365	194,705	164,435	368,880	381,545	282,170	90,700	59,246	117,880	67,340	50,920
Mean	2,330	3,440	6,280	5,480	11,700	19,400	8,460	2,930	1,970	3,800	2,240	1,640
Run-off in acre-feet	143,000	191,000	386,000	326,000	719,000	1,150,000	520,000	180,000	117,000	234,000	133,000	101,000
Maximum		8,640	13,500	7,440	16,130	27,600	16,400	4,480	4,390	6,120	2,640	1,910
Minimum		1,630	1,500	4,050	7,770	11,320	4,950	2,130	1,520	2,440	1,740	1,450
Accuracy	D	B	B	B	B	A	B	B	B	B	B	B

Daily discharge, in second-feet, of Green River at Little Valley, Utah, for 1912

Used rating table dated 7/29/12. Established January 1-8, February 1-12. January 27-31, December 28-31

Day	January discharge	February discharge	March discharge	April discharge	May discharge	June discharge	July discharge	August discharge	September discharge	October discharge	November discharge	December discharge
1	1,500	2,000	1,530	6,300	5,330	30,600	28,800	9,150	3,960	2,810	4,050	1,810
2	1,500	2,000	1,580	7,470	5,570	31,200	28,800	9,500	4,440	2,810	3,680	1,810
3	1,500	2,000	1,640	8,120	6,300	33,100	27,700	8,460	3,440	2,980	4,240	1,290
4	1,500	2,000	1,690	7,160	7,470	35,800	27,100	8,120	4,410	2,980	4,240	1,290
5	1,500	2,000	1,690	6,860	8,460	38,600	25,500	9,150	4,440	2,980	4,240	1,290
6	1,580	2,000	2,350	7,160	9,500	39,300	24,000	10,900	4,240	3,500	4,240	1,290
7	1,490	2,000	2,650	7,470	10,200	42,200	22,600	10,600	3,860	3,150	4,050	1,290
8	1,490	2,000	3,150	8,460	10,200	46,100	20,700	9,500	3,770	3,150	3,860	1,290
9	1,490	2,000	3,000	9,150	9,150	51,100	18,900	9,850	3,680	3,150	3,680	1,290
10	1,490	2,000	3,150	9,850	6,860	52,000	18,000	9,500	3,860	3,500	3,680	1,380
11	1,430	2,000	3,240	8,800	5,810	53,700	16,400	8,460	3,860	3,680	3,680	1,380
12	1,430	2,000	3,500	7,160	8,120	54,600	15,600	7,700	3,500	3,860	3,680	1,380
13	1,490	2,070	4,050	6,860	10,200	52,800	14,800	6,300	3,320	3,860	3,680	1,690
14	1,530	2,070	4,440	6,860	14,000	52,800	14,400	6,300	3,320	4,050	3,680	1,690
15	1,530	1,940	4,980	6,370	14,000	52,000	14,000	5,810	3,320	3,960	3,680	1,810
16	1,580	2,070	5,100	6,050	13,600	49,400	13,200	5,570	3,320	3,860	3,680	1,810
17	1,580	1,480	4,650	6,050	14,000	46,100	13,200	5,810	3,320	3,770	3,770	1,690
18	1,580	1,480	3,680	6,050	13,600	41,500	12,400	5,570	3,320	3,680	3,770	1,690
19	1,660	1,530	3,320	5,810	13,200	39,300	12,400	5,570	3,500	3,680	3,680	1,690
20	1,750	1,530	3,150	5,100	14,000	33,100	12,000	5,810	3,500	3,680	3,590	1,690
21	1,810	1,580	3,320	4,980	18,000	27,700	11,700	5,810	4,050	3,500	3,440	1,690
22	1,810	1,530	4,540	5,810	22,600	25,000	11,700	6,050	4,050	3,150	3,320	1,480
23	2,070	1,530	5,810	5,810	25,500	23,000	11,300	5,810	3,680	3,150	3,320	1,480
24	2,140	1,480	5,810	5,330	27,400	22,600	10,900	5,810	3,320	3,320	3,060	1,480
25	2,210	1,480	4,870	5,330	27,700	22,600	12,000	5,330	3,150	3,320	3,060	1,480
26	2,280	1,580	4,870	5,100	28,800	23,500	11,700	5,100	3,150	3,320	2,730	1,480

27	2,100	1,580	4,030	4,870	29,400	25,600	11,300	4,870	3,150	3,410	2,650	1,480
28	2,100	1,640	4,240	5,100	29,400	26,600	10,900	4,240	2,980	7,790	2,350	1,480
29	2,100	1,580	4,050	5,330	29,400	28,800	12,000	4,050	2,980	3,410	2,210	1,480
30	2,100	.....	4,050	5,570	30,600	28,800	10,900	3,860	2,810	5,810	2,210	1,480
31	2,100	.....	6,050	.....	30,600	.....	9,300	4,140	.....	4,050	.....	1,480
Total	53,350	52,150	114,350	196,540	498,670	1,128,900	504,400	212,790	108,730	113,320	103,170	47,240
Mean	1,720	1,800	3,690	6,550	16,100	37,630	16,300	6,860	3,620	3,660	3,510	1,520
Run-off in acre-feet	106,000	104,000	227,000	390,000	990,000	2,240,000	1,000,000	422,000	215,000	225,000	209,000	93,500
Maximum	2,280	.....	6,050	9,850	30,600	54,600	28,800	10,900	4,440	7,790	4,240	1,810
Minimum	.....	.....	1,530	4,870	5,330	22,600	9,300	3,860	2,810	2,810	2,210	1,280
Accuracy	B	B	A	A	A	A	A	A	B	B	A	B

Daily discharge, in second-feet, of Green River at Little Valley, Utah, for 1913.

[Used table dated 12/30/13. For December values see 1914 climatic form]

Day.	October discharge	November discharge	December discharge	January discharge	February discharge	March discharge	April discharge	May discharge	June discharge	July discharge	August discharge	September discharge
1	Ice—Est. 1,700 sec. ft.	2,400	Est. 2,400 sec. ft.—Ice	7,880	9,100	26,100	16,600	8,700	2,240	3,040	3,040	2,560
2		2,400		9,460	9,460	26,700	16,400	7,800	2,240	3,040	3,040	2,560
3		2,400		18,700	12,000	26,700	16,400	7,500	2,400	3,040	3,040	2,720
4		2,400		19,100	15,200	26,700	16,000	6,900	3,360	2,880	3,210	2,720
5		2,400		17,300	15,600	26,700	15,600	6,040	3,770	3,360	3,210	2,720
6	2,400	2,400		17,300	15,600	25,600	15,600	5,360	4,340	3,210	3,210	2,560
7	2,400	2,400		17,300	14,400	25,100	15,200	5,160	4,340	3,360	3,210	2,400
8	2,400	2,400		14,000	13,200	23,500	14,800	4,940	3,760	3,770	3,040	2,400
9	2,400	2,400	3,360	10,200	12,400	22,500	16,000	4,940	3,360	3,960	3,040	2,080
10	2,400	2,400	3,360	8,420	12,400	22,000	16,800	4,940	3,960	4,340	3,040	1,940
11	2,400	2,400	3,360	11,300	14,400	21,000	17,700	4,760	5,360	4,340	3,040	1,800
12	2,400	2,400	3,360	11,300	14,400	20,100	18,200	4,540	5,360	4,340	3,040	2,080
13	2,400	2,400	3,360	10,900	16,400	19,600	17,300	4,540	3,360	4,540	3,210	2,240
14	2,400	2,400	3,360	8,420	18,200	19,100	17,300	4,340	3,360	4,540	3,770	1,420
15	2,400	2,400	3,210	8,420	19,600	19,100	17,300	4,340	3,770	4,340	3,770	

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16	2,400	2,400	4,340	9,460	20,100	18,700	16,800	4,150	3,580	3,770	3,770	Ice jam — See 1914 sheet
17	2,400	Ice Est. 2,000 sec.-ft.	5,160	9,460	20,600	17,700	16,800	3,960	3,770	3,770	3,770	
18	2,400		5,160	10,900	20,100	17,700	16,400	3,770	3,580	3,770	3,770	
19	2,400		5,820	12,800	17,700	16,400	16,000	3,770	3,770	3,580	3,580	
20	2,400		6,040	15,200	16,000	14,800	15,600	3,770	3,770	3,580	3,580	
21	2,400		5,820	16,000	16,000	14,000	14,400	3,390	3,770	3,390	3,580	
22	2,400		5,820	15,200	16,000	14,000	13,600	3,210	3,580	3,390	3,390	
23	2,400		5,820	15,200	16,000	14,000	13,200	3,040	3,390	3,390	3,390	
24	2,400		5,820	16,400	16,000	13,200	12,400	2,880	3,390	3,390	3,390	
25	2,400		5,820	16,400	16,800	13,200	12,000	2,720	3,390	3,390	3,210	
26	2,400		5,820	14,800	17,300	12,800	11,700	2,560	3,770	3,210	3,210	
27	2,400		5,820	13,200	17,300	12,800	11,300	3,210	3,390	3,210	2,880	
28	2,400		5,820	10,900	18,700	12,800	10,900	2,560	3,210	3,210	2,720	
29	2,400		4,340	9,460	22,500	18,200	10,200	2,400	3,210	3,210	2,720	
30	2,400		4,340	9,100	23,500	22,000	9,460	2,240	3,040	3,040	2,720	
31	2,400		4,340		24,500		8,760	2,400		3,040		
Total	71,400	62,400	128,850	384,400	511,460	[illegible]	456,520	134,230	114,940	110,500	97,590	52,020
Mean	2,300	2,230	4,160	12,800	16,500	19,400	14,700	4,330	3,830	3,560	3,230	1,680
Run-off in acre-feet	141,000	124,000	256,000	762,000	1,010,000	1,150,000	[illegible]	266,000	228,000	219,000	193,000	103,000
Maximum	2,400		6,040	19,100	24,500	26,700	18,200	8,100	8,760	4,540	3,770	2,720
Minimum				7,800	9,100	12,800	8,760	2,240	2,240	2,880	2,720	
Accuracy	C	C	C	C	B	A	A	A	A	B	C	C

Daily discharge, in second-feet, of Green River at Little Valley, Utah, for the year ending September 30, 1914

[Affected by ice Dec. 25-Feb. 18. Drainage area, 41,040 square miles]

Day	October discharge	November discharge	December discharge	January discharge	February discharge	March discharge	April discharge	May discharge	June discharge	July discharge	August discharge	September discharge
1	3,040	3,040	2,560			6,300	6,300	19,600	48,700	23,000	6,040	3,580
2	3,040	3,040	2,560			5,380	6,900	17,300	50,800	23,000	6,300	3,360
3	3,040	3,040	2,720			4,340	8,100	16,400	48,700	22,000	6,300	3,210
4	2,880	3,210	2,720			3,300	7,800	16,000	48,700	21,000	6,300	3,120
5	3,360	3,210	2,720			3,960	7,800	15,600	48,700	23,000	6,300	3,040
6	3,210	3,210	2,560			5,380	7,500	16,000	48,700	22,500	6,300	2,880
7	3,390	3,210	2,400			6,040	7,500	17,700	48,700	21,500	6,300	2,720
8	3,770	3,040	2,400			5,380	7,800	19,100	48,700	20,100	6,300	2,640
9	3,960	3,040	2,090			5,160	7,800	20,400	48,700	19,100	6,040	2,640
10	4,340	3,040	1,940			3,300	9,460	20,600	45,900	18,200	5,820	2,560
11	4,380	3,040	1,800			5,380	14,800	21,000	41,000	16,400	5,600	2,480
12	4,340	3,040	2,090			6,900	14,800	23,000	36,900	15,200	5,600	2,400
13	4,540	3,210	2,240			7,500	14,400	26,100	32,600	14,000	5,160	2,400
14	4,540	3,770	1,420			6,040	14,400	27,200	30,900	13,200	4,740	2,320
15	4,340	3,770	1,360			5,380	14,000	28,200	29,800	12,400	4,540	2,320
16	3,770	3,770	1,160			5,380	13,600	28,800	29,800	11,300	4,340	2,320
17	3,770	3,770	1,200			5,820	12,000	27,200	30,400	10,200	4,150	2,400
18	3,770	3,770	1,200			7,200	11,300	27,700	29,800	9,460	3,960	2,480
19	3,580	3,580	1,200		2,160	10,000	12,400	28,200	29,300	9,460	3,770	2,480
20	3,580	3,580	1,160		2,090	12,800	16,800	28,200	28,200	9,100	3,580	2,480
21	3,390	3,580	1,200		2,160	12,800	16,400	30,900	28,200	9,100	3,360	2,480
22	3,390	3,390	1,160		3,040	9,460	14,000	32,000	28,200	8,760	3,210	2,480
23	3,390	3,390	1,160		2,640	8,100	13,200	33,200	27,200	8,760	3,210	2,480
24	3,390	3,390	1,120		3,040	6,900	15,200	37,500	26,700	8,420	3,360	2,640
25	3,390	3,210			2,640	6,600	16,000	38,200	27,200	8,420	3,210	2,560
26	3,210	3,210			4,340	6,040	16,400	41,700	27,200	8,100	3,040	2,400

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27	3,210	2,880	1,130		5,380	5,380	19,600	44,500	26,100	7,900	3,210	2,480
28	3,210	2,720			7,200	4,740	17,300	44,500	25,600	7,800	3,040	2,480
29	3,210	2,720				5,160	16,800	45,900	25,100	7,500	3,210	2,480
30	3,040	2,720				5,380	17,300	45,900	24,000	7,200	3,390	2,480
31	3,040					6,900		45,900		6,600	3,390	
Total	110,500	97,300	52,020	60,000	73,900	199,300	377,600	884,200	1,070,500	422,580	143,130	78,740
Mean	3,560	3,250	1,680	1,950	2,640	6,430	12,600	28,500	35,700	13,600	4,620	2,620
Run-off in acre-feet	219,000	193,000	103,000	120,000	147,000	395,000	750,000	1,750,000	2,129,000	836,000	284,000	156,000
Maximum	4,540	3,770	2,720		7,200	12,800	19,600	45,900	50,800	23,000	6,300	3,580
Minimum	2,880	2,720				3,300	6,300	15,600	24,000	6,600	3,040	2,320
Accuracy	B	C	C	C	C	B	A	A	A	A	A	B

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Daily discharge, in second-feet, of Green River at Little Valley, Utah, for the year ending September 30, 1915

Old staff gage, Oct. 1 to Nov. 7. Corrected to true datum. Auto gage, Nov. 8 to Sept. 30. Discharge during frozen season estimated from discharge measurements, climatological data, and observer's notes.

	October discharge	November discharge	December discharge	January discharge	February discharge	March discharge	April discharge	May discharge	June discharge	July discharge	August discharge	September discharge
1	3,960	3,680	2,260			Frozen estimate mean flow = 2,000 sec. ft.	4,690	10,400	11,800	11,100	2,680	1,460
2	2,720	3,480	2,230				4,810	11,500	12,200	10,500	2,580	1,470
3	2,800	3,480	1,980				4,830	13,000	13,500	10,200	3,050	1,530
4	4,540	3,480	2,030				4,810	13,900	15,500	9,380	2,930	1,740
5	3,480	3,480	1,970				4,880	13,200	16,200	8,800	2,740	1,780
6	3,120	3,480	2,080				4,950	11,900	18,300	8,320	2,640	1,730
7	4,340	3,300	2,140		1,560	2,440	5,070	10,900	17,200	7,960	2,550	1,980
8	3,860	3,290	2,240			2,470	5,410	9,900	17,000	7,640	2,530	2,290
9	3,480	3,270	2,230			2,470	5,610	9,270	17,100	7,480	2,420	2,070
10	3,680	3,210	1,970			2,520	6,140	8,560	16,800	7,320	2,340	1,960
11	5,270	3,120	1,440			2,610	6,080	8,020	17,000	7,190	2,200	2,260
12	5,710	3,110	1,260			2,640	6,900	7,510	17,600	6,860	2,260	2,770
13	4,540	3,030	1,180			2,820	6,140	7,260	18,800	6,500	2,230	3,090
14	4,540	2,980	Est. mean = 1,140 sec.-ft.			3,030	6,480	7,480	19,200	6,360	2,080	2,880
15	4,540	2,930				3,560	6,740	7,700	18,300	6,080	1,890	2,920
16	4,340	2,880				4,000	7,010	8,730	17,700	5,740	1,860	2,850
17	4,150	2,820				3,450	7,290	10,700	15,900	5,460	1,900	2,900
18	4,150	2,690				3,230	7,380	13,000	15,400	5,190	1,900	2,720
19	3,860	2,550	1,100			3,200	8,090	14,300	15,900	4,950	1,860	2,600
20	3,860	2,420				3,290	8,980	14,400	15,900	4,830	1,840	2,470
21	3,860	2,290				3,230	9,710	14,700	15,200	4,950	1,780	2,420
22	3,680	2,140				3,270	9,980	13,900	15,200	5,020	1,760	2,470
23	3,680	2,000				3,380	9,630	12,900	14,800	4,720	1,710	2,400
24	3,680	1,850				3,410	10,400	11,800	15,200	4,500	1,680	2,400
25	3,480	1,670				3,320	11,000	10,900	15,000	4,200	1,640	5,000

Est. mean = 1,200 sec.-ft.

River frozen — Discharge estimated mean — Flow = 1,500 Sec. Ft.

River frozen — Est. 1,000 sec.-ft.

26	3,680	1,670	1,490			3,300	11,200	10,400	14,500	3,880	1,600	6,340
27	3,680	1,660	1,400			3,600	10,600	10,700	13,800	3,540	1,560	5,360
28	3,860	1,670	1,300			3,940	9,980	10,700	13,200	3,300	1,530	4,880
29	4,150	1,880	1,290			4,040	9,670	10,900	12,300	3,270	1,540	7,960
30	4,150	2,180	1,480			4,220	9,710	10,900	11,700	2,950	1,550	8,800
31	3,860		1,500			4,540		11,200		2,740	1,500	
Total	122,700	81,690	47,470	46,500	49,460	94,070	223,170	340,630	468,200	190,930	64,330	93,550
Mean	3,960	2,720	1,530	Est.1,500	Est.1,770	3,030	7,440	11,000	15,600	6,160	2,080	3,120
Run-off in acre-feet	243,000	162,000	94,100	92,200	98,300	186,000	443,000	676,000	928,000	379,000	128,000	186,000
Maximum	5,710	3,680	2,260			4,540	118,200	14,700	19,200	11,100	3,050	8,800
Minimum	2,720	1,660	1,100				4,690	7,260	11,740	2,740	1,600	1,460
Accuracy	B	B	C	C	C	B	A	A	A	A	B	A

Daily gage discharge, in second-feet, of Green River at Little Valley, Utah, for the year ending September 30, 1916

[File number Washington 3015. Table of use: Half tenths 1.0 ft. to 4.0 ft.]

[Drainage area, 41,000 square miles. (Rage, Friez recorder. Used rating table dated Feb. 26, 1917]

NOTE.—Max. stage, 8.48 feet 10 a. m. May 13 (discharge 30,800 sec. ft.) Min. stage below −0.5 on Dec. 22 (see note below). An ice jam Dec. 21-22 produced an abnormally low flow. The gorge was above Greenriver, Utah. The minimum flow was probably less then 300 second-feet.

Day	October discharge	November discharge	December discharge	January discharge	February discharge	March discharge	April discharge	May discharge	June discharge	July discharge	August discharge	September discharge
1	8,440	2,800	2,080			2,720	8,700	21,300	18,500	15,600	6,720	2,970
2	8,000	2,720	1,780	1,690		2,630	8,880	22,800	19,900	14,900	6,280	2,970
3		2,630	1,650		1,720	2,630	9,250	22,300	20,400	14,900	6,420	2,970
4	5,960	2,630	1,620	1,760		2,800	8,880	19,400	20,400	14,900	6,280	2,970
5		2,540	1,870			2,880	8,170	18,000	20,800	14,900	6,720	2,800
6		2,540	2,050			3,240	7,660	17,600	21,300	14,500	8,170	2,800
7	3,910	3,040	2,240			2,880	7,660	17,100	22,800	14,100	7,500	2,720
8	3,810	3,710	2,300			2,880	7,660	17,600	23,300	13,200	7,500	2,800
9	3,710	3,150	2,380	1,720	2,140	3,090	7,830	20,800	22,800	12,800	8,520	2,630
10	3,630	3,240	2,490			3,520	7,830	24,800	22,800	12,400	7,500	2,800
11	3,520	3,240	2,460			3,910	7,500	28,200	23,800	11,600	7,180	2,540
12	3,520	3,150	2,460			4,220	7,500	30,300	24,300	10,800	7,180	2,630
13	3,420	3,330	2,380			4,530	7,340	30,300	24,300	10,400	7,340	2,800
14	3,490		2,460			6,040	7,500	30,300	25,200	10,000	6,720	2,720
15	3,530					10,400	8,170	28,200	26,200	10,000	6,870	2,630
16	3,240					15,100	10,000	26,200	26,200	10,000	7,180	2,540
17	3,240	2,860	2,060		2,380	16,000	12,400	24,300	26,200	9,250	6,720	2,800
18	3,240				2,380	14,900	12,400	22,300	25,200	8,880	5,730	2,800
19	3,240		1,550		2,380	14,500	12,400	19,400	24,800	8,520	5,340	2,630
20	3,240	2,380	450	1,690	2,380	14,100	12,400	17,600	24,300	8,170	5,220	2,460
21	3,240	2,380	300		2,380	13,200	12,800	16,700	25,200	7,830	4,750	2,380
22	3,240	2,380	250		2,630	13,200	13,200	15,800	26,200	8,000	4,420	2,300

23	3,150	2,380	1,600		2,540	15,400	13,200	15,800	26,200	7,680	4,110	2,270
24	3,150	2,460	1,620		2,540	17,100	12,400	16,700	26,200	7,340	4,040	2,250
25	3,060	2,630	1,550		2,540	17,600	11,600	19,400	25,200	6,870	3,810	2,300
26	3,060	2,880	"		2,540	16,700	11,600	18,500	23,800	6,570	3,620	2,300
27	2,970	2,970	1,480		2,630	13,700	12,400	17,600	21,300	6,420	3,420	2,190
28	2,970	2,800	"	1,960	2,720	12,000	14,100	17,600	19,400	6,420	3,330	2,100
29	2,880	2,630	1,410	"	2,720	10,800	15,800	17,600	17,100	8,340	3,240	2,060
30	2,800	2,380	1,480	1,760		9,820	18,500	17,600	15,800	8,340	3,240	1,990
31	2,800		1,550	"		8,880		17,600		7,180	3,150	
Total	122,060	85,020	54,720	53,180	64,900	281,340	315,730	649,700	689,900	320,590	178,190	77,120
Mean	3,940	2,830	1,770	1,720	2,240	9,080	10,500	21,000	23,000	10,300	5,750	2,570
Run-off in acre feet	242,000	168,000	109,000	105,000	129,000	558,000	625,000	1,290,000	1,370,000	653,000	354,000	153,000
Maximum	3,440	3,910			2,720	17,600	18,500	30,500	26,200	15,500	8,520	2,970
Minimum	2,800	2,380				2,630	7,340	15,800	15,800	6,420	3,150	1,990
Accuracy												

NOTE.—Revised record for Dec. and monthly discharge for 1916 published in 1917 report W. S. P. 459.

Daily discharge, in second-feet, of Green River at Little Valley, Utah, for the year ending September 30, 1917

NOTE.—Max. stage 14.58 ft. 6 a. m. June 27, discharge 65,600 sec. ft. Min. stage —0.15 ft. 11 a. m. Nov. 18, discharge 995 sec. ft. Affected by ice Dec. 28 to Mar. 3. Used rating table dated Aug. 24, 1920.

	October discharge	November discharge	December discharge	January discharge	February discharge	March discharge	April discharge	May discharge	June discharge	July discharge	August discharge	September discharge
1	2,570	3,620	2,250	1,500	1,300	3,800	8,670	20,400	33,500	59,400	12,600	3,810
2	3,330	3,520	2,150			3,800	14,000	17,400	34,100	57,600	11,800	3,710
3	3,520	3,520	2,080			3,800	9,580	14,900	35,200	54,000	10,900	3,610
4	4,110	3,520	2,300			3,420	8,180	14,000	34,600	51,600	10,900	3,610
5	3,520	3,520	2,710			3,150	7,080	15,900	31,800	49,200	10,500	3,610
6	4,010	3,420	2,970			3,330	6,240	15,400	31,800	45,700	9,760	3,520
7	8,180	3,330	3,060			2,970	5,600	13,100	33,500	42,100	8,860	3,420
8	4,430	3,330	2,150			2,800	5,360	11,800	34,100	38,600	8,180	3,420
9	5,600	3,240	1,480			2,880	6,380	11,300	32,900	36,900	7,540	3,610
10	7,890	3,240	1,370			3,060	7,380	10,900	31,800	35,200	7,230	3,810
11	11,300	3,150	1,320			3,060	9,760	10,900	33,500	33,500	6,940	4,110
12	7,380	3,150	1,140			3,060	14,000	11,300	38,100	32,400	6,790	5,000
13	7,850	3,060	1,470			3,150	15,400	12,600	41,000	30,700	6,790	4,110
14	6,650	2,880	1,760			3,150	16,400	14,900	44,500	29,000	6,240	4,110
15	5,730	2,300	1,880			3,060	15,900	17,400	46,800	26,300	5,980	4,430
16	5,980	1,760	1,940			3,150	15,900	20,900	46,800	24,600	5,730	4,650
17	6,110	1,190	2,150			3,060	14,500	26,800	46,200	22,500	5,600	4,770
18	5,480	1,070	2,300			2,970	13,100	30,700	46,200	20,900	5,480	4,540
19	4,540	1,240	2,220			2,880	11,800	34,600	48,000	19,400	5,240	4,110
20	4,220	1,640	1,950			2,880	10,100	38,600	51,000	17,400	5,240	3,910
21	4,220	1,890	2,150			3,150	9,760	41,000	54,000	15,900	5,120	3,810
22	4,110	2,180	2,010			3,240	9,390	42,700	55,860	14,900	4,880	3,810
23	4,010	2,090	2,150			3,240	8,860	43,900	58,800	14,000	4,770	4,320
24	3,910	1,880	2,150			3,710	8,680	44,500	61,200	13,100	4,650	4,320
25	3,810	1,910	2,150			4,010	9,390	44,500	63,100	12,600	4,430	4,110

1,100

3,000

1588

26	3,810	1,910	2,460			3,910	12,600	41,000	64,300	12,200	4,220	4,430
27	3,710	2,250	2,380			3,610	17,400	39,800	66,700	11,800	4,110	4,220
28	3,710	2,460	1,900			3,710	19,900	39,800	65,500	11,800	4,010	3,910
29	3,710	2,380	1,900			3,710	22,500	39,800	63,100	11,300	4,010	3,810
30	3,710	2,380	1,900			3,610	24,100	37,500	61,200	10,900	3,910	3,710
31	3,710	----------	1,900			4,540	----------	34,600	----------	11,800	3,810	----------
Total	154,820	76,950	63,700	40,100	58,500	103,870	357,910	812,900	1,389,100	867,800	206,320	120,320
Mean	4,990	2,560	2,060	1,290	2,090	3,350	11,900	26,200	46,300	28,000	6,660	4,010
Run-off in acre-feet	307,000	152,000	127,000	79,300	116,000	206,000	708,000	1,610,000	2,760,000	1,720,000	410,000	239,000
Maximum	11,300	3,620	3,060	----------	----------	4,540	24,100	44,500	66,700	59,400	12,600	5,060
Minimum	2,570	1,070	1,140	----------	----------	2,800	5,360	10,900	31,800	10,900	3,810	3,420

Daily discharge, in second-feet, of Green River at Little Valley, Utah, for the year ending September 30, 1918

[Gage, Fries rec., Stevens continuous. Used rating table dated 8-24-20]

Day	October discharge	November discharge	December discharge	January discharge	February discharge	March discharge	April discharge	May discharge	June discharge	July discharge	August discharge	September discharge
1	3,710	2,970	3,330	3,240	2,400	3,150	5,600	6,240	14,900	23,000	4,880	1,870
2	3,710	3,060	3,330	3,240	2,350	2,970	5,860	6,380	15,400	20,400	4,540	1,880
3	3,810	3,060	3,330	3,330	2,300	3,060	6,110	6,380	14,900	17,900	4,320	1,830
4	3,710	3,060	3,240	3,330	2,220	3,060	6,110	6,110	14,500	15,900	4,110	1,880
5	3,710	3,060	3,240	3,330	2,150	2,970	6,240	5,980	14,000	14,500	3,810	2,880
6	3,710	3,060	3,150	3,330	2,060	3,060	6,380	6,380	13,500	13,100	3,910	2,270
7	3,320	2,970	3,060	3,150	2,110	3,150	6,650	7,090	14,900	12,200	3,710	2,020
8	3,320	3,060	2,800	2,970	2,120	3,240	6,790	10,500	15,900	10,800	3,620	2,300
9	3,420	3,150	2,630	2,800	2,160	3,330	6,240	13,500	17,900	9,780	3,420	2,380
10	3,420	3,240	2,460	3,060	2,300	3,620	5,730	15,900	20,400	10,300	3,420	2,460
11	3,420	3,240	2,260	2,460	2,380	3,620	5,390	17,900	24,600	12,200	3,710	2,460
12	3,330	3,240	2,000	1,820	2,460	4,220	5,260	18,400	27,900	13,100	3,820	2,630
13	3,240	3,240	1,940	1,300	2,460	4,220	5,480	18,400	30,100	12,200	3,330	2,540
14	3,150	3,240	1,800	1,200	2,540	4,010	5,980	16,900	31,800	14,000	3,620	2,380
15	3,330	3,240	1,910	1,500	2,540	4,880	6,630	15,400	32,500	14,500	4,320	2,300
16	3,060	3,240	2,000	1,460	2,460	5,730	7,540	13,500	35,200	14,500	3,620	2,140
17	3,060	3,240	2,300	1,420	2,460	5,390	8,690	12,600	36,300	12,600	3,910	2,050
18	3,060	3,240	2,460	1,460	2,540	5,120	9,210	13,100	37,500	11,500	3,820	2,000
19	2,970	3,150	2,630	1,860	2,460	5,000	9,390	14,900	37,500	10,900	3,240	1,970
20	2,970	3,060	2,630	2,040	2,460	4,540	8,860	16,400	38,100	10,500	3,060	1,960
21	2,970	3,060	2,720	2,300	2,280	4,320	8,010	16,900	38,600	10,100	2,880	1,930
22	2,970	3,060	2,720	2,630	2,460	4,220	7,230	17,400	39,200	9,390	2,720	1,940
23	3,060	3,060	2,720	2,460	2,540	4,110	6,510	16,900	40,400	8,680	2,630	3,240
24	3,060	3,060	2,800	2,300	2,720	4,010	5,980	16,900	42,100	8,190	2,540	3,420
25	3,060	2,970	2,800	2,280	2,880	4,010	5,600	15,900	43,300	7,540	2,460	4,010
26	2,970	2,880	2,630	2,270	2,880	4,010	5,260	15,900	43,300	7,230	2,380	4,430

1590

27	2,970	2,800	2,880	2,100	2,800	4,220	5,120	16,900	40,400	6,790	2,270	3,630
28	2,970	2,880	3,060	1,950	3,060	4,430	5,240	17,400	35,800	6,510	2,450	3,910
29	2,970	3,060	2,970	1,950	.....	4,660	5,360	17,400	31,200	6,110	2,050	3,430
30	3,060	3,240	3,240	2,000	.....	5,000	5,730	16,900	27,300	5,480	1,970	3,060
31	3,060	.....	3,240	2,300	.....	5,240	.....	16,400	.....	5,240	1,920	.....
Total	100,950	92,890	94,420	72,900	68,600	126,540	194,240	426,960	871,400	355,910	101,560	77,160
Mean	3,260	3,100	2,720	2,350	2,450	4,080	6,470	13,800	29,000	11,500	3,280	2,570
Run-off in acre-feet	200,000	184,000	187,000	144,000	136,000	251,000	385,000	848,000	1,730,000	707,000	202,000	153,000
Maximum	3,810	3,240	3,330	3,330	3,060	5,730	9,390	18,400	43,300	23,600	4,880	4,430
Minimum	2,970	2,800	1,800	1,200	2,000	2,970	5,120	5,980	13,500	5,240	1,920	1,530

Daily discharge, in second-feet, of Green River at Little Valley, Utah, for the year ending September 30, 1919

[File Number Washington 3015. Used rating table dated 8-24-20 and 10-25-20]

Day	October discharge	November discharge	December discharge	January discharge	February discharge	March discharge	April discharge	May discharge	June discharge	July discharge	August discharge	September discharge
1	2,970	3,520	1,530				7,850	14,500	19,900	3,420	936	834
2	2,970	3,520	1,480				8,180	13,500	19,900	3,150	1,270	2,380
3	2,880	3,420	1,580				8,180	13,100	18,900	2,970	1,430	2,460
4	2,800	3,330	1,760				8,180	13,500	18,400	2,800	1,700	1,880
5	2,800	3,420	2,010			2,000	8,680	14,000	16,900	2,630	1,580	2,010
6	2,000	3,420	2,150				8,680	14,500	14,900	2,460	1,640	2,220
7	3,150	3,420	2,380				8,180	14,000	13,100	2,380	1,550	1,700
8	3,240	3,420	2,460				8,180	14,000	11,300	2,230	1,380	1,760
9	4,220	3,420	2,540				8,340	14,000	10,500	2,150	1,450	1,820
10	3,710	3,420	2,720			2,010	8,510	14,500	9,390	2,010	1,420	2,010
11	3,910	3,420	2,880			2,080	8,010	13,100	8,850	1,940	1,320	2,080
12	4,430	3,420	2,970			2,150	6,940	12,200	8,340	1,820	1,530	2,150
13	4,430	3,330	2,630	1,400		2,150	6,240	11,800	8,000	1,880	1,480	1,880
14	4,110	3,240	2,380			2,300	5,730	11,300	7,850	1,700	1,440	1,760
15	3,910	3,150	2,300			2,380	5,360	10,900	7,850	1,580	1,440	1,820
16	3,710	3,150	2,300			2,460	5,240	10,500	7,690	1,720	1,340	1,820
17	3,910	3,150	2,010			2,720	5,120	10,900	7,380	1,450	1,230	1,760
18	4,010	3,150	2,010			3,150	4,880	12,200	7,080	1,470	1,180	1,700
19	3,910	3,150	2,150			3,910	5,000	13,100	6,940	1,660	900	1,640
20	4,220	3,150	2,460			4,430	5,000	13,500	6,510	1,480	986	1,700
21	4,650	3,240	2,880			5,120	4,880	14,900	6,240	1,320	1,020	1,640
22	3,910	3,150	2,720			6,870	4,880	15,900	5,980	1,250	954	1,580
23	3,710	3,000	2,540			10,900	5,480	17,900	5,600	1,180	942	1,580
24	3,810	2,970	2,150			9,390	6,940	17,900	5,360	1,120	1,020	1,460
25	3,910	2,720	1,820			9,760	8,680	18,400	5,000	1,020	974	1,460
26	3,710	2,380	1,640			10,100	10,500	18,900	4,660	1,020	900	1,410

27	3,710	1,820	1,530	.....	.....	8,850	12,600	18,900	4,430	980	880	1,420
28	3,710	1,480	1,480	1,580	.....	8,180	14,500	19,400	4,110	940	875	1,880
29	3,620	1,420	1,350	.....	.....	7,540	14,900	19,400	3,910	900	850	1,870
30	3,630	1,530	1,480	1,550	.....	7,380	15,400	19,900	3,620	865	842	1,910
31	3,530	.....	1,310	.....	.....	7,540	.....	19,900	.....	850	838	.....
Total	114,230	90,390	85,600	44,030	49,000	139,370	239,240	460,500	278,500	54,395	37,290	53,634
Mean	3,680	3,010	2,120	1,420	•1,750	4,500	7,970	14,900	9,200	1,750	1,200	1,790
Run-off in acre-feet	226,000	179,000	130,000	87,300	97,200	277,000	474,000	916,000	553,000	108,000	73,800	107,000
Maximum	4,650	3,520	2,970	.....	.....	10,900	15,400	19,900	19,900	3,420	1,700	2,460
Minimum	2,800	1,420	1,310	.....	.....	.....	4,880	10,500	3,620	850	838	834

• Estimated.

Daily discharge, in second-feet, of Green River at Little Valley, at Greenriver, Utah, for the year ending September 30, 1920

[Gage, Stevens continuous]

[File number Washington 3015. Used rating table dated 10-25-20.]

Day	October discharge	November discharge	December discharge	January discharge	February discharge	March discharge	April discharge	May discharge	June discharge	July discharge	August discharge	September discharge
1	1,890	2,260	510			2,870	4,600	4,580	47,500	19,700	5,610	3,110
2	1,680	2,280	660			2,800	4,120	4,830	48,500	18,900	5,250	3,000
3	1,670	2,200	820			3,080	3,740	5,340	49,100	17,400	5,610	2,870
4	1,640	2,180	1,140			3,110	3,480	6,350	48,100	16,600	5,300	2,760
5	1,600	2,170	1,300	1,720		3,210	3,500	9,330	45,200	16,400	5,100	2,800
6	1,700	2,100	1,470			3,300	3,260	12,300	40,300	15,400	6,220	2,960
7	1,720	2,080	1,530			3,280	3,130	13,900	37,300	14,600	5,640	2,750
8	1,730	2,450	1,560			3,170	3,170	14,600	36,500	13,800	4,900	2,960
9	1,780	2,290	1,560		2,320	3,020	3,660	16,000	36,900	13,200	4,580	3,060
10	1,880	2,280	1,550			2,980	4,620	18,000	38,100	12,300	4,470	2,800
11	2,040	2,370				2,890	5,440	19,400	39,600	11,700	4,580	2,840
12	2,240	2,340				3,080	6,870	20,900	40,000	10,900	4,600	2,710
13	2,180	2,450				3,660	9,210	22,600	39,500	10,200	4,180	2,750
14	2,120	2,390				4,360	10,600	24,100	39,200	9,530	3,800	2,520
15	2,050	2,230	1,450	1,500		4,530	10,300	25,000	38,100	8,870	3,660	2,520
16	1,900	2,120				4,850	10,200	25,800	36,700	8,250	3,480	2,430
17	2,000	1,960				4,140	10,700	26,100	34,700	7,980	3,320	2,390
18	2,020	1,820			2,430	4,310	11,800	28,200	33,100	7,590	3,230	2,340
19	2,120	1,830			2,400	4,050	12,300	29,500	31,800	7,250	3,250	2,470
20	2,080	1,850			2,400	4,030	11,300	29,600	30,400	6,930	5,440	2,320
21	2,040	1,990			2,480	3,860	9,570	31,100	28,300	6,590	6,370	2,400
22	2,020	2,120			2,710	3,860	7,590	35,300	26,400	6,480	5,320	2,290
23	2,040	2,200			2,760	4,140	6,650	39,200	24,800	6,650	5,440	2,190
24	2,120	2,230	1,750		2,420	4,620	6,090	42,100	23,300	6,670	5,080	2,050
25	2,180	2,320		2,000	2,340	4,900	5,710	43,700	22,800	6,430	4,010	2,060

26	2,170	2,430			2,390	5,130	5,370	44,700	21,300	6,270	3,780	2,060
27	2,170	2,290			2,660	5,220	5,030	45,400	20,800	6,220	4,220	2,110
28	2,220	1,860			3,040	5,010	4,830	46,500	21,100	6,240	3,620	2,140
29	2,240	1,280	1,700		3,040	5,130	4,620	46,800	21,800	6,090	3,660	2,180
30	2,240	710	1,680			5,250	4,550	48,100	20,800	5,840	3,520	2,290
31	2,240					5,080		48,100		5,810	3,300	
Total	61,810	63,050	45,660	54,200	70,510	122,920	196,010	828,430	1,021,700	316,820	140,540	76,120
Mean	1,990	2,100	1,470	1,750	2,430	3,970	6,530	26,700	34,100	10,200	4,530	2,540
Run-off in acre-feet	122,000	125,000	90,600	108,000	140,000	244,000	389,000	1,640,000	2,030,000	627,000	279,000	151,000
Maximum	2,240	2,450			3,040	5,250	12,300	48,100	49,100	19,700	6,370	3,110
Minimum	1,600	710	510			2,800	3,130	4,580	20,800	5,810	3,220	2,050

Daily discharge, in second-feet, of Green River at Little Valley near Green River, Utah, for the year ending September 30, 1921

[Gage, Stevens continuous]

[File number, Washington 3015. Used rating table dated Oct. 25, 1920, as base]

Day	October discharge	November discharge	December discharge	January discharge	February discharge	March discharge	April discharge	May discharge	June discharge	July discharge	August discharge	September discharge
1	2,290	3,440	2,420	1,670	2,290	6,040	5,250	9,100	42,200	22,800	6,930	4,640
2	2,310	3,760	2,390	1,680	2,320	9,330	5,130	8,390	43,200	21,500	7,040	4,490
3	2,400	4,120	2,140	↑	2,290	10,500	5,100	8,460	44,100	19,900	6,620	4,670
4	2,390	3,740	2,140	|	2,290	11,200	5,060	9,020	44,900	18,500	6,160	4,490
5	2,370	3,500	2,290	|	2,180	11,100	5,060	10,100	45,400	16,900	5,800	4,400
6	2,350	3,360	2,280	1,900	2,220	11,400	5,060	12,400	45,400	15,900	5,500	4,580
7	2,350	3,360	2,320	|	2,240	10,500	5,390	16,300	45,300	14,800	5,220	4,420
8	2,320	3,380	2,200	|	2,400	10,300	6,160	21,000	45,300	↑	5,490	4,270
9	2,280	3,760	2,200	|	2,340	11,300	7,460	25,300	50,000	|	5,490	4,270
10	2,280	3,660	2,170	|	2,280	9,690	8,460	27,700	54,000	12,000	5,980	4,160
11	2,220	3,520	2,120	|	2,200	8,010	8,180	29,200	57,000	|	5,300	4,010
12	2,220	3,480	2,110	|	2,170	7,430	7,490	27,300	58,800	|	5,250	3,890
13	2,290	3,460	2,000	1,750	2,180	6,870	6,760	23,700	59,700	8,760	4,600	3,780
14	2,350	3,600	1,960	↓	2,450	6,400	6,240	21,900	62,600	8,180	4,020	3,640
15	2,350	3,520	1,950	•	2,940	6,140	6,160	22,000	63,900	8,080	6,320	3,480
16	2,350	3,210	1,380	↑	2,780	6,040	6,620	22,900	64,100	8,250	5,640	3,230
17	2,370	2,910	1,190	2,000	2,710	6,010	7,560	24,700	64,100	8,500	5,200	3,040
18	2,390	2,750	1,100	|	3,000	6,000	7,680	28,000	62,600	9,900	4,900	2,910
19	2,400	2,600	1,160	|	3,440	6,240	8,140	31,000	59,800	9,130	4,580	2,800
20	2,570	2,620	1,230	↑	4,010	6,650	8,110	33,300	58,000	8,360	4,220	2,760
21	2,690	2,780	1,410	|	4,100	6,760	7,650	34,100	53,100	8,040	5,250	2,670
22	2,940	2,940	1,810	|	4,160	6,960	7,750	33,500	44,500	7,590	5,250	2,670
23	3,040	3,280	2,220	|	4,140	7,130	8,010	31,100	37,000	7,400	5,980	2,920
24	3,060	3,420	2,340	|	4,120	7,220	9,210	28,900	33,200	7,120	6,700	2,590
25	3,020	3,460	2,240	2,150	4,310	6,810	9,770	29,800	30,900	6,840	4,960	2,570

26	3,000	3,540	2,000		4,850	6,460	9,900	31,500	28,400	6,870	6,620	2,480
27	3,000	3,340	1,520		4,400	6,220	10,100	32,900	27,100	6,460	4,850	2,430
28	3,100	3,190	1,510		4,670	6,010	10,300	34,600	26,000	6,140	4,990	2,420
29	3,150	2,940	1,610			5,840	10,200	35,800	25,000	5,940	4,870	2,350
30	3,210	2,750	1,600			5,660	9,530	36,800	24,000	5,880	4,710	2,310
31	3,760		1,710			5,460		39,200		5,610	5,510	
Total	80,820	99,390	58,780	61,100	85,180	237,740	223,490	779,970	1,399,600	333,350	170,550	103,040
Mean	2,610	3,310	1,900	1,970	3,040	7,670	7,450	25,200	46,700	10,800	5,500	3,430
Run-off in acre-feet	160,000	197,800	117,000	121,000	169,000	472,000	443,000	1,550,000	2,780,000	664,000	338,000	204,000
Maximum	3,760	4,120	2,420		4,670	11,400	10,300	39,200	64,100	22,800	7,040	4,670
Minimum	2,220	2,600	1,100		2,170	5,460	5,060	8,390	24,000	5,610	4,220	2,310

Daily discharge, in second-feet, of Green River at Little Valley, near Greenriver, Utah, for the year ending September 30, 1922

[Gage, Stevens continuous. Used rating tables dated 10-25-20 and 2-7-23]

Day	October discharge	November discharge	December discharge	January discharge	February discharge	March discharge	April discharge	May discharge	June discharge	July discharge	August discharge	September discharge
1	2,280	2,280	2,690	2,500	1,900	3,010	6,060	11,500	45,600	21,700	4,060	4,650
2	2,260	2,390	2,620	2,580	1,800	2,830	5,530	13,000	44,400	20,000	4,900	4,290
3	2,230	2,500	2,600	2,580	1,900	2,740	5,270	14,000	43,200	18,400	3,830	4,180
4	2,200	2,500	2,500	2,500	1,800	2,420	5,020	14,800	40,200	16,800	4,060	4,060
5	2,180	2,500	2,450	2,280	1,850	2,210	5,140	15,300	38,400	15,800	4,180	3,940
6	2,220	2,500	2,450	2,280	2,080	2,210	5,140	16,000	38,400	14,300	4,060	3,940
7	2,220	2,450	2,420	2,080	2,210	2,280	5,790	17,600	38,600	13,200	3,610	3,940
8	2,310	2,420	2,280	1,690	2,350	2,350	6,610	19,800	39,000	11,800	3,610	3,830
9	2,590	2,370	2,100	955	1,850	2,350	6,760	22,500	40,200	10,800	3,400	3,520
10	2,590	2,350	1,540	1,060	1,850	2,350	7,360	29,000	43,200	9,990	3,400	3,200
11	2,500	2,370	1,350	1,260	2,210	2,500	7,510	31,000	45,200	9,590	3,720	3,100
12	2,450	2,370	1,260	1,370	2,350	2,500	7,050	30,200	45,800	8,850	3,400	3,010
13	2,420	2,340	1,290	1,410	3,010	2,500	6,900	28,400	44,600	8,000	3,300	2,920
14	2,430	2,320	1,500	1,690	3,200	2,660	6,330	24,500	43,200	7,510	3,300	2,740
15	2,460	2,340	1,780	1,740	3,200	3,010	5,990	21,700	41,600	6,760	3,100	2,660
16	2,450	2,370	1,980	2,080	2,350	3,200	5,270	20,300	39,800	6,470	3,400	2,580
17	2,400	2,470	1,940	1,740	2,210	4,180	4,980	20,300	36,900	6,200	3,200	2,500
18	2,350	2,480	1,540	1,960	2,080	7,050	4,700	20,300	35,100	5,790	2,920	2,420
19	2,320	2,500	1,540	1,540	2,080	17,600	4,410	21,400	34,200	5,270	2,920	2,350
20	2,290	2,470	1,610	1,450	2,140	19,000	4,200	23,000	35,100	4,900	3,400	2,280
21	2,240	2,400	2,030	1,540	2,280	12,500	4,290	27,900	36,300	4,650	4,530	2,210
22	2,230	2,400	2,280	1,740	2,920	10,600	4,290	31,000	35,700	4,180	5,660	2,140
23	2,220	2,450	2,880	1,640	2,830	9,790	4,290	33,000	35,700	3,940	8,680	2,140
24	2,540	2,420	3,100	1,450	3,010	10,200	4,530		35,400	3,830	5,530	2,080
25	2,760	2,570	3,360	1,450	3,200	12,000	5,020	36,700	33,000	3,940	5,090	2,020
26	2,280	2,520	2,970	1,540	3,400	12,500	6,330		30,700	3,940	4,650	2,020

27	2,290	2,600	2,410	1,640	3,720	11,100	7,670	40,400	28,700	3,830	4,060	1,960
28	2,310	2,710	2,220	1,540	3,500	9,590	8,850	42,000	26,400	3,830	3,830	1,960
29	2,260	2,780	2,110	1,690	.....	8,000	9,590	42,600	25,000	4,060	3,940	1,960
30	2,240	2,760	2,290	1,800	.....	7,200	10,600	43,400	23,100	4,060	4,180	1,960
31	2,220	.....	2,460	1,590	.....	6,610	.....	44,000	.....	4,060	4,290	.....
Total	72,730	73,900	67,550	54,365	69,280	199,040	181,370	829,900	1,122,700	266,450	126,210	86,560
Mean	2,350	2,460	2,180	1,750	2,470	6,420	6,050	26,800	37,400	8,600	4,070	2,890
Run-off in acre-feet	144,000	146,000	134,000	108,000	137,000	395,000	360,000	1,650,000	2,230,000	529,000	250,000	172,000
Maximum	2,760	2,780	3,360	2,580	3,720	19,000	10,600	44,000	45,800	21,700	8,680	4,650
Minimum	2,180	2,280	1,260	955	1,800	2,210	4,290	11,500	23,100	3,830	2,920	1,960

NOTE.—Max. stage recorded 10.80 feet at 1 p. m. June 12 (discharge 46,200 sec.-ft.) Minimum stage recorded (staff gage)—0.15 at Jan. 9 (discharge 955 sec.-ft.).

Daily discharge, in second-feet, of Green River at Little Valley, near Greenriver, Utah, for the year ending Sept. 30, 1923

[File number, Washington 3015]

[Gage, Stevens continuous. Used rating table dated 2-7-23 as standard]

[NOTE.—Datum lowered 1.00 foot Oct. 22, 1922. Maximum stage recorded 11.1 feet on May 31 (discharge 42,000 second-feet). Minimum stage recorded 1.47 feet at 11 a. m. Dec. 22 (discharge 1,350 second-feet)]

Day	October discharge	November discharge	December discharge	January discharge	February discharge	March discharge	April discharge	May discharge	June discharge	July discharge	August discharge	September discharge
1	1,980	2,690	2,400	1,930	2,160	2,560	12,700	13,400	41,500		9,750	4,410
2	2,130	2,560	2,470	1,810	2,220	2,750	14,600	14,000	39,800		9,100	4,200
3	2,040	2,550	2,600	1,880	2,280	3,050	16,300	14,700	37,000		8,640	3,990
4	2,020	2,660	2,680	1,940	2,270	3,010	14,500	15,400	35,800	16,800	8,330	3,830
5	2,000	2,660	2,690	1,960	2,280	2,710	12,200	15,300	35,600		8,160	3,810
6	1,980	2,740	2,660	2,040	2,080	2,680	11,100	15,700	34,100			
7	1,970	2,830	2,530	2,070	1,900	2,850	9,910	16,500	32,900			3,410
8	1,960	2,810	2,500	2,030	1,750	3,070	8,990	18,500	32,200	15,300		
9	2,010	2,810	2,500	2,070	1,760	3,320	9,400	22,200	31,400	14,600	6,680	
10	2,020	2,800	2,210	2,400	1,670	3,420	10,100	25,500	30,400	14,000		3,010
11	2,020	2,780	2,020	2,600	1,850	3,340	10,200	26,300	29,700	13,600		2,870
12	2,010	2,810	1,960	2,610	1,960	3,320	9,440	28,100	30,700	13,400	5,200	2,760
13	2,000	2,800	1,660	2,500	2,040	3,380	8,640	29,400	33,300	13,460	5,450	2,710
14	1,970	2,730	1,940	2,360	2,060	3,650	8,570	29,700	35,300	12,800	6,110	2,730
15	1,960	2,580	2,360	2,400	1,960	3,650	8,680	27,900	37,600	12,400	5,000	2,900
16	1,980	2,470	2,740	2,410	2,040	3,570	9,400	25,100	37,800	12,200	5,040	2,850
17	2,000	2,470	2,610	2,340	2,060	3,530	10,000	23,600	37,500	12,500	5,690	2,900
18	2,010	2,460	2,270	2,240	2,080	3,260	9,910	22,600	36,900	11,800	5,450	2,830
19	2,010	2,460	1,970	2,090	2,110	3,070	9,910	21,100	35,200	11,200	5,040	2,800
20	2,020	2,470	1,830	2,020	2,120	3,160	10,200	21,400	33,000	11,900	5,100	2,800
21	2,030	2,470	1,680	2,000	2,120	3,050	11,400	23,900	29,900	11,400	5,020	2,800
22	2,040	2,420	1,540	2,090	2,170	2,870	14,000	27,300	27,300	10,400	4,850	3,010

1600

23	2,060	2,420	1,590	2,240	2,220	2,940	16,400	29,900	25,800	9,590	4,670	3,160
24	2,090	2,470	1,640	2,290	2,350	3,090	15,000	31,700	23,300	9,250	4,510	3,220
25	2,120	2,560	1,690	2,310	2,460	3,240	13,200	32,000	21,400	9,400	4,290	3,140
26	2,130	2,560	1,730	2,250	2,520	3,340	12,500	32,800	20,500	9,210	4,240	3,360
27	2,140	2,500	1,730	2,250	2,420	4,180	11,600	35,100	20,500	9,480	4,060	3,570
28	2,170	2,380	1,900	2,250	2,410	4,870	11,400	38,100	20,900	10,600	3,880	3,550
29	2,180	2,340	2,020	2,360	----------	5,660	11,400	40,200	19,800	13,200	3,790	3,810
30	2,250	2,350	2,010	2,240	----------	7,260	12,400	41,400	18,400	11,600	3,570	3,810
31	2,580	----------	1,960	2,160	----------	10,000	----------	42,000	----------	10,400	4,240	----------
Total:	63,910	77,610	66,090	68,140	59,320	113,850	344,050	800,800	925,500	401,230	179,260	99,080
Mean	2,060	2,590	2,130	2,200	2,120	3,670	11,500	25,800	30,800	12,900	5,780	3,300
Run-off in acre-feet	127,000	154,000	131,000	135,000	118,000	226,000	682,000	1,590,000	1,830,000	796,000	356,000	196,000
Maximum	2,580	2,830	2,740	2,610	2,520	10,000	16,400	42,000	41,000	----------	9,750	4,410
Minimum	1,960	2,340	1,540	1,810	1,670	2,560	8,570	13,400	18,400	9,210	3,570	2,710

Daily discharge, in second-feet, of Green River near Greenriver, Utah, for the year ending September 30, 1924

[File number Washington-3015. Used rating table dated Feb. 7, 1923, and Oct. 18, 1924]

[Gage read to Stevens Cont. once a day and chain]

[Station moved from Little Valley to Green River on June 21]

	October discharge	November discharge	December discharge	January discharge	February discharge	March discharge	April discharge	May discharge	June discharge	July discharge	August discharge	September discharge
1	3,760	3,610	2,900	↑	↑	5,200	3,030	8,680	16,800	5,730	1,790	1,190
2	3,590	3,530	2,850	↑	↑	4,800	3,050	7,770	15,900	5,370	1,710	1,160
3	3,650	3,500	↑	1,500	↑	↑	2,880	7,670	15,300	5,080	1,630	1,140
4	3,880	3,500	↑	↓	↑	↑	2,780	7,830	15,100	4,840	1,580	1,140
5	4,480	3,500	↑	↑	1,600	4,150	2,940	8,190	14,200	4,630	1,660	1,130
6	4,410	3,480	↑	1,000	↑	↑	3,500	9,540	13,800	4,460	1,580	1,110
7	4,010	3,400	2,360	1,000	↑	↑	6,280	12,300	13,400	4,320	1,490	1,090
8	4,110	3,300	↑	1,100	↑	↑	12,100	13,900	13,900	4,260	1,470	1,090
9	4,200	3,300	↑	1,200	↑	3,500	16,000	14,500	14,500	4,010	1,450	1,090
10	4,430	3,760	↑	[20] 1,470	↑	↑	18,800	[21] 14,100	15,300	3,930	1,390	6,140
11	↑	3,790	1,870	1,500	↑	↑	21,000	13,400	15,900	4,230	[27] 1,370	3,480
12	↑	3,460	↑	↑	↑	↑	21,600	12,800	14,600	4,180	1,380	1,450
13	↑	↑	1,870	↑	↑	↑	20,000	12,100	12,800	4,150	1,360	1,410
14	↑	3,460	↓	↑	2,000	↑	17,500	12,700	12,600	4,260	1,490	1,850
15	↑	↓	1,870	↑	↓	3,050	15,700	14,500	13,000	4,460	1,710	1,490
16	4,000	3,460	↑	↑	↑	↓	15,000	16,700	13,700	4,340	1,790	1,320
17	↓	↑	1,850	↑	[21] 2,350	↑	15,300	17,900	14,300	4,070	1,790	1,280
18	↑	↑	↓	↑	2,480	↑	17,400	19,200	14,600	3,650	1,940	1,200
19	↑	↑	↑	↑	[22] 2,760	↓	15,800	20,500	14,400	3,270	1,660	1,210
20	↑	↑	1,900	↑	2,960	[23] 2,600	12,500	22,100	[26] 13,400	3,110	[28] 1,480	[29] 1,220
21	↓	↑	↓	1,500	3,420	2,630	10,400	23,400	12,400	2,950	1,390	1,240
22	3,570	↑	1,930	↑	4,360	2,800	9,030	24,300	12,000	2,740	1,320	1,260
23	3,570	↑	↑	↑	4,900	2,870	8,260	23,200	11,300	2,590	1,300	1,270

24	3,720	3,250			5,400	2,970	7,860	21,500	9,830	2,490	1,280	1,300
25	3,630				5,500	2,900	8,330	20,800	9,190	2,370	1,260	1,290
26	3,650		1,850			2,850	9,210	19,800	8,540	2,190	1,260	1,260
27	3,610				5,310	2,830	10,300	19,600	7,640	2,130	1,240	1,250
28	3,550					2,730	11,600	18,500	6,940	2,100	1,240	1,220
29	3,550		1,870		5,120	2,6[illegible]	11,400	18,300	6,390	2,600	1,260	1,240
30	3,550		1,980			2,780	9,790	18,500	5,970	2,030	1,220	1,260
31	3,590		1,950			2,940		18,000		1,910	1,180	
Total	120,510	101,470	64,080	44,770	83,180	102,480	339,340	492,280	377,700	112,450	45,670	44,980
Mean	3,890	3,386	2,070	1,440	2,870	3,310	11,300	15,900	12,600	3,630	1,470	1,500
Run-off in acre-feet	239,000	201,000	127,000	88,800	165,000	204,000	672,000	978,000	750,000	223,000	90,400	89,300
Maximum		3,790	2,900			5,200	21,600	24,300	16,800	5,730	1,940	6,140
Minimum	3,550						2,780	7,670	5,970	1,910	1,180	1,090

Daily discharge, in second-feet of Green River at Greenriver, Utah, for the year ending September 30, 1925

[Gage, Stevens' continuous]

[Used rating table dated 1-28-25]

NOTE.—Maximum oil recorded May 26 at 11 p. m. 1,014 feet.

	October discharge	November discharge	December discharge	January discharge	February discharge	March discharge	April discharge	May discharge	June discharge	July discharge	August discharge	September discharge
1	1,290	2,220	1,790				5,780	6,080	18,600	12,600	4,360	3,900
2	1,290	2,220	1,630				6,040	6,620	19,000	12,500	4,190	5,140
3	1,290	2,190	1,550	1,100		3,200	6,940	7,180	19,600	13,200	4,060	4,980
4	1,280	2,190	1,500				6,570	7,610	20,100	13,700	4,130	5,740
5	1,250	2,210	1,470				6,300	8,650	19,800	14,000	4,300	4,060
6	1,260	[36] 2,170	1,670			3,350	5,780	9,800	19,300	15,300	3,900	3,960
7	1,630	2,130	1,850			4,300	5,530	11,000	17,300	15,400	3,870	3,870
8	2,160	2,100	1,990			5,250	5,290	11,200	16,000	15,400	3,570	3,810
9	1,540	2,160	1,930			6,210	6,390	11,600	15,500	15,100	3,320	3,430
10	1,470	2,270	1,790			9,500	8,150	12,500	14,500	14,500	3,320	3,410
11	1,480	2,220	1,380			9,700	7,710	13,200	13,500	13,000	[39] 3,810	3,220
12	1,490	2,170	1,120			8,350	[33] 6,900	13,900	13,200	11,500	4,800	3,490
13	1,540	2,190	922		2,300	6,080	6,390	14,200	[38] 13,100	9,950	3,750	3,280
14	1,520	2,160	901			4,760	6,340	13,800	12,000	[37] 8,800	3,870	3,030
15	1,540	2,060	901			3,960	6,710	13,600	11,400	7,860	4,100	2,960
16	1,640	1,900	1,010	[31] 1,500		3,490	8,000	13,400	10,800	7,040	4,470	3,030
17	1,790	1,820	1,280			3,180	9,550	13,600	9,850	6,340	4,330	3,030
18	1,820	1,810	1,480			2,920	10,000	14,200	9,450	5,740	4,160	2,980
19	1,820	1,810	1,550			2,740	10,800	14,300	9,800	5,290	4,580	2,800
20	1,820	1,890	1,190			2,550	11,700	14,300	10,100	4,720	4,830	4,910
21	1,790	1,950	1,040			2,430	12,000	13,400	11,000	4,260	5,490	6,710
22	1,810	1,920	900			2,360	12,200	14,200	13,000	4,270	4,260	6,240
23	1,830	1,950	800			2,430	10,600	15,700	12,900	6,940	4,300	5,370

24	1,880	1,980	700			2,720	9,700	16,400	12,700	6,850	3,870	4,760
25	1,900	2,000				3,250	9,000	18,600	12,300	6,300	3,350	4,830
26	1,960	2,170				4,030	8,500	20,100	13,700	5,910	3,490	5,820
27	2,040	2,160			2,700	5,060	8,100	20,100	14,500	6,040	4,870	5,780
28	2,160	1,920	600		2,800	5,370	7,080	19,600	13,800	6,040	7,810	5,450
29	2,220	1,810		1,600		5,910	6,480	18,600	13,300	5,740	5,060	4,720
30	2,270	1,760				6,660	6,080	18,600	12,900	5,290	6,440	4,160
31	2,170					6,170		18,300		4,720	4,870	
Total	52,950	61,570	36,544	45,000	65,300	138,730	236,610	424,340	423,000	287,300	135,530	135,870
Mean	1,710	2,050	1,180	1,450	2,330	4,480	7,890	13,700	14,100	9,270	4,370	4,530
Run-off in acre-feet	105,000	122,000	72,600	89,200	129,000	275,000	469,000	842,000	839,000	570,000	269,000	270,000
Maximum	2,270	2,270	1,990		2,800	9,700	12,200	20,100	20,100	15,400	7,810	9,800
Minimum	1,250	1,760				2,360	5,290	6,080	9,450	4,260	3,320	2,960

Daily discharge, in second-feet, of Green River at Greenriver, Utah, for the year ending September 30, 1926

[Drainage area, 38,200 square miles. Gage, Stevens continuous. Used rating table dated 12-7-26]

[Maximum stage, 10.67 feet at 10 p. m. May 26. Maximum discharge, 24,500 second-feet. Stage, 10.43 feet at 10 p. m. May 9. Minimum stage, 4.84 feet at 1 p. m. on Dec. 20. Discharge, 1,140 second-feet]

Day	October discharge	November discharge	December discharge	January discharge	February discharge	March discharge	April discharge	May discharge	June discharge	July discharge	August discharge	September discharge
1	4,040	3,620	2,880	2,040	1,760	2,500	5,560	17,200	23,700	4,600	2,700	1,760
2	3,820	3,620	2,970	2,060	1,760	2,600	4,980	17,800	21,700	4,250	2,520	1,740
3	3,680	3,620	3,160	2,080	1,830	2,700	4,560	18,500	19,600	3,990	2,440	1,700
4	3,540	3,620	3,110	2,120	1,970	3,040	4,190	19,300	19,000	3,870	2,410	1,700
5	6,280	3,620	3,180	2,120	2,000	3,280	4,020	19,500	19,200	3,870	2,460	1,660
6	9,990	3,760	3,260	[4]2,120	2,040	3,410	3,760	21,300	18,700	3,990	2,480	1,700
7	4,660	3,760	3,040	[4]2,200	2,120	3,960	4,040	22,900	17,600	4,500	2,620	1,680
8	5,320	3,760	2,790	2,120	2,150	4,440	4,280	23,500	17,000	4,690	2,770	1,740
9	5,490	3,620	2,730	1,970	2,200	4,280	4,890	24,000	16,500	5,520	3,180	1,760
10	5,490	3,620	[4]2,810	1,970	2,200	4,130	6,470	23,500	16,400	6,540	3,520	1,730
11	6,020	3,490	2,810	1,970	2,230	4,660	8,420	20,300	16,200	9,250	[3]5,290	1,730
12	6,580	3,360	2,770	1,900	2,280	4,690	11,600	17,700	15,300	16,100	5,120	2,280
13	6,200	3,360	2,540	1,900	2,330	4,310	10,800	15,500	14,800	13,600	6,240	1,820
14	6,200	3,360	2,520	1,900	2,370	4,660	10,300	13,700	14,300	12,400	5,980	1,640
15	5,490	3,360	2,560	1,970	2,390	5,220	10,600	12,300	14,600	10,200	5,420	1,560
16	5,150	3,360	2,520	1,970	2,480	5,460	10,400	11,200	14,000	8,720	4,410	1,540
17	4,980	3,300	2,100	1,830	2,460	5,910	10,100	10,200	13,100	7,580	4,070	1,510
18	4,820	3,240	1,440	1,760	2,480	6,500	9,900	9,710	12,600	6,700	4,130	1,440
19	4,660	3,180	1,250	1,760	2,520	7,660	10,100	9,800	12,100	5,950	3,730	1,410
20	4,500	3,110	1,240	1,700	2,540	7,910	10,600	10,900	8,980	5,320	3,310	1,410
21	4,500	2,930	1,420	1,700	2,540	8,200	12,000	12,500	8,070	4,720	3,040	1,400
22	4,340	2,730	1,580	1,830	2,460	8,940	13,800	14,800	9,160	4,130	2,860	1,400
23	4,190	2,680	1,830	1,830	2,520	8,630	14,900	17,100	8,330	3,760	2,620	1,380
24	4,040	2,620	2,200	1,900	2,420	8,200	15,800	19,800	7,700	3,520	2,420	1,340

25	3,990	2,660	2,200	1,830	2,420	7,860	17,300	22,100	7,010	3,390	2,390	1,310
26	3,900	2,730	2,120	1,760	2,390	7,370	18,300	23,900	6,430	3,260	2,180	1,260
27	3,760	2,620	2,120	1,700	2,410	6,890	17,700	23,700	5,910	2,970	2,090	1,290
28	3,760	2,600	2,220	1,640	2,420	6,890	16,000	23,400	5,560	2,950	2,030	1,260
29	3,620	2,620	2,120	1,700		7,050	16,000	23,300	5,180	2,860	1,860	1,280
30	3,620	2,730	2,040	1,760		6,350	16,700	23,000	4,890	2,770	1,930	1,830
31	3,620		2,040	1,700		5,950		22,900		2,790	1,860	
Total	150,250	96,660	73,550	58,810	63,690	173,650	208,070	565,310	393,620	178,760	100,080	47,260
Mean	4,850	3,220	2,370	1,900	2,270	5,600	10,300	18,200	13,100	5,770	3,230	1,580
Run-off in acre-feet	298,000	192,000	146,000	117,000	126,000	344,000	613,000	1,120,000	780,000	355,000	199,000	94,000
Maximum	9,990	3,760	3,260	2,200	2,540	8,940	18,300	24,000	23,700	16,100	6,240	2,280
Minimum	3,540	2,600	1,240	1,640	1,760	2,500	3,760	9,710	4,890	2,770	1,860	1,260

Daily discharge, in second-feet, of Green River at Greenriver, Utah, for the year ending September 30, 1927

[Gage, continuous rec. Used rating table dated 12-7-26 and 11-15-27]

[Maximum stage, 13.20 feet at 5.30 p. m., on June 28. Discharge, 46,300 second-feet]

Day	October discharge	November discharge	December discharge	January discharge	February discharge	March discharge	April discharge	May discharge	June discharge	July discharge	August discharge	September discharge
1	1,570	1,550	2,230		1,800	2,330	5,290	13,900	16,200	24,800	5,150	3,310
2	1,800	1,550	2,230		1,850	2,420	5,740	16,800	14,900	24,200	4,890	3,090
3	2,370	1,560	2,220		[56] 1,900	2,520	5,940	18,000	13,700	24,000	4,890	2,880
4	2,320	1,570	2,220		1,860	2,840	6,130	19,500	13,000	24,300	4,720	2,660
5	2,840	1,590	2,200	1,400	1,830	3,520	6,620	21,600	12,500	26,300	5,020	2,560
6	2,440	1,630	2,230		1,900	3,260	6,810	22,600	12,400	24,400	5,080	2,460
7	2,560	1,640	2,330		2,080	3,440	6,780	21,900	[59] 12,200	18,800	4,660	3,110
8	2,440	1,630	2,300		2,150	4,020	7,410	21,500	12,500	16,000	4,530	10,500
9	2,260	1,600	2,350	1,550	2,380	4,500	7,490	20,300	13,900	16,100	4,340	8,630
10	2,120	1,590	2,440	1,600	2,620	4,130	6,740	21,300	15,600	15,600	4,020	8,630
11	2,030	1,620	2,460	1,650	1,940	4,600	6,500	23,000	17,100	14,500	3,820	6,780
12	2,000	1,640	2,370	[55] 1,690	1,730	4,470	7,130	19,500	19,800	13,400	3,870	12,500
13	1,940	1,650	2,320	1,700	2,050	4,130	7,620	15,300	22,900	12,200	3,990	26,400
14	1,930	1,660	1,970	1,700	2,370	3,570	7,950	13,000	25,400	11,100	3,820	27,500
15	1,890	1,700	1,650	1,750	2,180	3,090	8,370	11,400	26,300	10,400	3,730	18,900
16	1,830	1,730	1,400	1,750	1,980	3,180	7,990	12,000	27,000	9,430	3,340	10,200
17	1,800	1,730	1,150	1,800	1,780	3,140	6,660	[57] 13,900	29,400	8,590	3,210	7,980
18	1,800	[54] 1,740	875	1,800	1,750	3,620	5,600	19,200	30,700	7,860	3,090	7,720
19	1,820	1,710	900	1,850	1,760	3,840	5,180	24,500	32,700	7,290	3,020	7,670
20	1,800	1,750		1,850	1,790	3,460	4,820	29,200	30,900	6,890	2,970	7,500
21	1,750	1,820		1,800	1,800	3,360	4,440	31,400	29,800	6,540	2,790	6,990
22	1,710	1,800		1,700	1,820	3,140	4,690	31,000	29,000	7,050	2,750	6,580
23	1,690	1,760		1,650	1,820	2,840	6,130	29,500	27,000	6,700	2,770	7,630
24	1,660	1,740		1,750	1,890	2,790	6,130	28,100	25,100	5,770	2,760	[60] 6,580
25	1,640	1,790	1,200	1,850	2,000	2,860	5,560	[58] 27,300	24,000	5,600	2,750	[61] 6,380

26	1,650	1,900		1,800	2,180	3,280	4,980	25,200	22,300	5,700	2,750	7,630
27	1,630	1,900		1,800	2,330	3,620	4,950	21,300	21,000	5,980	2,930	10,200
28	1,620	2,040		1,750	2,350	3,990	6,020	18,600	25,900	6,500	3,160	8,530
29	1,580	2,120		1,750		4,410	7,820	17,900	30,500	5,420	3,760	6,870
30	1,580	2,150		1,800		4,720	10,500	17,700	28,300	5,520	4,190	7,070
31	1,570			1,800		4,820		16,800		5,390	3,626	
Total	59,640	51,860	52,245	51,340	55,890	109,910	193,990	643,200	662,000	382,330	116,400	255,440
Mean	1,920	1,730	1,690	1,660	2,009	3,550	6,470	20,700	22,100	12,300	3,750	8,510
Run-off in acre-feet	118,000	103,000	104,000	102,000	111,000	218,000	385,000	1,270,000	1,320,000	756,000	231,000	506,000
Maximum	2,840	2,150	2,460	1,850	2,620	4,820	10,500	31,400	32,700	26,300	5,150	27,500
Minimum	1,570	1,550	875		1,730	2,330	4,440	11,400	12,200	5,390	2,750	2,460

Daily discharge, in second-feet, of Green River at Greenriver, Utah, for the year ending September 30, 1928—Continued

Daily discharge, in second-feet, of Green River at Greenriver, Utah, for the year ending September 30, 1928

[Gage Stevens Continued]

[Used rating table dated Dec. 7, 1926, as standard]

Maximum stage, 13.1 feet at 11 p. m. on May 31. Discharge, 44,700 second-feet

Minimum stage recorded, 5.34 feet (chain gage reading) at 9.30 a. m. on Dec. 11 (discharge, 1,350 second-feet)

[Drainage area, 23,800 square miles]

Day	October discharge	November discharge	December discharge	January discharge	February discharge	March discharge	April discharge	May discharge	June discharge	July discharge	August discharge	September discharge
1	7,170	5,520	3,410	2,300	2,680	3,160	9,520	17,000	44,400	11,160	4,160	2,640
2	7,290	4,340	3,680	2,300	2,600	3,490	8,160	20,800	43,600	10,800	3,960	2,440
3	6,850	4,920	4,020	2,300	2,660	3,960	6,970	22,200	42,800	10,600	3,870	2,410
4	6,130	5,150	4,160	2,300	2,680	4,160	6,240	26,400	42,000	10,600	4,950	2,350
5	5,770	4,530	3,870	2,300	2,750	4,660	6,060	27,100	39,200	10,800	4,950	2,320
6	5,660	4,500	3,680	2,370	2,700	5,290	6,810	25,000	34,400	10,600	4,790	2,280
7	5,740	4,380	3,000	2,600	2,700	5,980	7,780	22,200	30,400	10,100	4,790	2,200
8	6,060	4,130	2,100	2,860	2,860	5,840	7,740	20,400	25,800	9,160	4,790	2,150
9	5,910	4,070	1,560	3,000	3,040	5,350	7,170	21,500	22,600	8,500	4,630	2,100
10	5,630	3,870	1,400	3,060	2,970	5,180	6,660	25,400	20,900	7,860	4,310	2,060
11	5,350	3,900	1,350	3,000	3,000	5,290	6,090	27,900	20,200	7,530	4,040	2,020
12	5,120	3,900	1,500	2,950	2,860	5,490	5,700	32,300	19,800	7,250	4,040	1,960
13	4,950	3,990	1,800	3,000	2,790	5,880	5,250	36,300	19,100	7,580	3,900	1,900
14	4,720	4,410	2,060	3,000	2,840	6,240	4,850	38,700	17,700	7,620	3,760	1,840
15	4,500	4,600	2,100	3,090	2,790	6,700	4,690	40,300	17,000	7,130	3,620	1,830
16	4,410	4,920	2,000	3,300	2,620	6,850	4,600	38,700	16,700	6,470	3,900	1,820
17	4,280	4,790	1,900	3,410	2,680	6,060	4,530	36,700	16,400	5,910	3,490	1,800
18	4,250	4,560	1,830	3,400	2,680	5,660	4,470	34,300	15,200	5,700	4,190	1,800

19	4,070	4,440	1,800	3,300	2,390	5,120	4,410	30,700	14,600	5,630	3,360	1,820
20	3,960	4,440	1,790	3,140	2,350	4,890	4,340	29,100	14,600	5,660	3,110	1,800
21	4,020	4,340	1,800	3,110	2,500	4,980	4,720	27,100	14,100	6,020	3,040	1,790
22	3,990	4,250	2,000	2,880	2,540	5,080	5,740	25,700	13,400	5,800	2,840	1,750
23	3,960	4,130	2,140	2,880	2,560	5,740	6,810	26,800	12,300	5,700	[68] 2,660	1,710
24	3,870	4,070	2,000	2,880	2,600	7,370	6,850	[68] 29,100	11,000	5,660	2,600	1,706
25	3,820	3,960	1,840	2,770	2,660	8,460	6,970	31,100	10,800	5,700	2,580	1,700
26	3,700	4,190	2,000	2,660	2,810	9,070	7,010	33,100	10,700	5,490	3,000	,690
27	3,590	4,690	2,200	2,560	2,840	9,850	7,250	35,500	10,600	5,150	3,760	3,800
28	3,730	3,820	2,370	2,460	2,900	10,900	8,810	37,900	11,900	4,890	3,040	3,620
29	4,820	3,520	2,400	2,560	2,970	11,700	11,100	40,700	11,400	4,660	2,860	1,780
30	4,190	3,280	2,300	2,560	-------	11,200	11,800	43,100	11,100	4,470	2,790	1,780
31	5,490	-------	2,320	2,560	-------	9,800	-------	44,300	-------	4,810	2,700	-------
Total	153,600	129,610	72,380	86,860	79,020	199,400	199,100	947,400	634,700	224,450	114,480	62,860
Mean	4,940	4,320	2,330	2,800	2,720	6,430	6,640	30,600	21,200	7,240	3,690	2,100
Run-off in acre-feet	304,000	257,000	143,000	172,000	156,000	395,000	395,000	1,880,000	1,260,000	445,000	227,000	125,000
Maximum	7,290	5,520	4,160	3,410	3,040	11,700	11,800	44,300	44,400	11,100	4,950	3,800
Minimum	3,590	3,280	1,350	2,300	2,350	3,160	4,340	17,000	10,600	4,310	2,580	1,690

COMPLAINANT'S EXHIBIT 567

[4–208—Oil and Gas Prospecting Permit—Form No. 1]

THE UNITED STATES OF AMERICA

DEPARTMENT OF THE INTERIOR

GENERAL LAND OFFICE

U. S. LAND OFFICE AT SALT LAKE CITY

Serial No. 026375.

Know all men by these presents, That the Secretary of the Interior, under and by virtue of the act of Congress entitled, "An Act to promote the mining of coal, phosphate, oil, oil shale, gas, and sodium on the public domain," approved February 25, 1920, has granted and does hereby grant a permit to FRANK SHAFER granting him the exclusive right for two years from the date hereof to prospect for oil or gas, but for no other purpose, the following-described lands: All Sec. 25, E. ½ Sec. 26, NE. ¼ Sec. 35; N. ½ Sec. 36, T. 26 S., R. 20 E., and all Sec. 30, N. ½ Sec. 31, T. 26 S., R. 21 E., S. L. M., unsurveyed, 2,400 acres, more or less.

[Amended Oct. 21, 1925, as to description of land covered by permit, as follows] Beginning at a point 7½ miles S. and 3 miles W. from NE. corner Sec. 34, T. 25 S., R. 21 E., S. L. M., and running thence W. 1 mile; N. 1½ mile; W. 1 mile; N. ½ mile; W. ½ mile; N. ½ mile; E. 2½ mile; S. 2½ mile to place of beginning, covering approximately all Sec. 25; NE. ¼ Sec. 26, T. 26 S., R. 20 E., all Secs. 30 and 31, T. 26 S., R. 21 E.; NW. ¼ Sec. 5; NE. ¼ Sec. 6, T. 27 S., R. 21 E., S. L. M., Utah, containing 2,400 acres, more or less upon the express conditions following:

1. To mark each of the corners of the claim within ninety days from date hereof with substantial monuments so that the boundaries can be readily traced on the ground, and post in a conspicuous place, upon the lands covered hereby, a notice that such a permit has been granted, and a description of the lands covered by this permit.

2. Within six months from date hereof to install upon some portion of the lands a substantial and adequate drilling outfit and to commence actual drilling operations.

3. Within one year from date hereof to drill one or more wells, not less than 6 inches in diameter to a depth of at least 500 feet each, unless valuable deposits of oil or gas shall be sooner discovered.

4. Within two years from date hereof to drill one or more wells to a depth of at least 2,000 feet, unless valuable deposits of oil or gas shall be sooner discovered.

5. Not to drill any well within 200 feet of any of the outer boundaries of the lands covered by this permit unless the adjoining lands have been patented or the title thereto otherwise vested in private owners.

6. To carry on all operations hereunder in accordance with approved methods and practice; to use all reasonable precautions to prevent waste of oil or gas developed in the land, or the entrance of water through wells drilled by permittee to the oil sands or oil bearing strata to the destruction or injury of the oil deposits, and to carry out, at the expense of the permittee, all reasonable orders of the Secretary of the Interior relative to prevention of waste and preservation of property, and to comply with such regulations

as may be issued by the Secretary of the Interior as to methods of operation.

7. To furnish and maintain during the period of this permit a bond with qualified corporate surety, in the sum of $1,000 conditioned against the failure of the permittee to repair promptly, so far as possible, any damage to the oil strata or deposits resulting from improper methods of operation.

8. That as to any lands covered by this permit embraced at the date hereof in any entry or patent with a reservation of the oil and gas deposits to the United States, pursuant to the act of July 17, 1914 (38 Stat. 509), or the act of December 29, 1916 (39 Stat. 862), permittee shall reimburse such entryman or patentee for all damage to crops and improvements caused by drilling or other prospecting operations.

9. That this permit is granted upon the express condition that the right is reserved to the Secretary of the Interior to permit upon such terms as he may determine to be just, for joint or several use, such easements or rights of way including easements in tunnels upon, through, or in the lands covered hereby, as may be necessary or appropriate to the working of the same, or of other lands containing the deposits described in the act under which this permit is granted.

10. This permit is granted on the express condition that if any of the land covered thereby is embraced in a forest, reclamation, power or other withdrawal, or is segregated for any particular purpose, operations under this permit shall be so conducted as not to interfere with the administration and use of the land for the purpose for which withdrawn or segregated to a greater extent than may be determined by

the Secretary of the Interior to be necessary for the most beneficial use of the land.

11. The granting of this permit shall not preclude the allowance of entry, location, or selection of any of the lands included therein, where such entry, selection, or location is made with a reservation of the mineral deposits to the United States.

12. That until this permittee shall apply for a lease to one-quarter or more of the area included herein, he shall pay to the United States 20 per cent of the gross value of all oil or gas secured by him from the lands and sold or otherwise disposed of, or held by him for sale or other disposition.

13. The Secretary of the Interior reserves the right and authority to cancel this instrument for failure of the permittee to comply with any of the conditions enumerated herein or to exercise due diligence in the work of development.

Valid rights existing at the date of this permit will not be affected thereby. Dated this 23rd day of December, 1920.

ALEXANDER T. VOGELSANG,
First Assistant Secretary of the Interior.

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COMPLAINANT'S EXHIBIT 609

Mineral lease application No. 565. Mineral lease No. 456. Grant: School

UTAH STATE OIL LAND LEASE

This INDENTURE OF LEASE AND AGREEMENT, entered into, in duplicate, this 22nd day of Jan., A. D. 1926, by and between the State Land Board, acting in behalf of the State of Utah, hereinafter called the lessor, and TEXAS PRODUCTION COMPANY, A Corporation of Colorado, hereinafter called the lessee, under and pursuant to Chapter 118, Laws of Utah, 1921:

WITNESSETH: That the lessor, in consideration of the rents and royalties to be paid and the covenants to be observed by the lessee, as hereinafter set forth, does hereby grant and lease to the lessee, the exclusive right and privilege of mining and operating for petroleum, oil, gas, naphtha, asphaltum, and kindred substances in, or under the following described lands, situated in GRAND AND SAN JUAN COUNTIES, Utah, to wit:

The acreage embraced within the mean high-water mark or either side of the Colorado River, within the boundaries of the following-described unsurveyed lands, to wit:

Commencing at a point which bears South 5 miles and West 4 miles from the Southwest corner of Section Twenty-six (26), Township Twenty-five (25) South, Range Twenty-one (21) East, S. L. M., running thence West 1 mile; thence South 2 miles; thence East ½ mile; thence south 1 mile; thence

East 1 mile; thence North 1 mile, thence East ½ mile; thence North 1 mile; thence West 1 mile; thence north 1 mile to the place of beginning; which when officially surveyed will probably conform to Sections Twenty-five (25), and Thirty-six (36), Township Twenty-six (26) South, Range Twenty (20) East, S. L. M. and Section Thirty-one (31), Township Twenty-six (26) South, Range Twenty-one (21) East, S. L. M. and Section Six (6), Township Twenty-seven (27) South, Range Twenty-one (21) East, S. L. M.; containing 170 acres, more or less.

Also the acreage embraced within the mean high water mark on either side of the Colorado River, within the boundaries of the following described unsurveyed lands, to wit:

Commencing at a point which bears South 9 miles and West 6½ miles from the Southwest corner of Section Twenty-six (26), Township Twenty-five South, Range Twenty-one (21) East, S. L. M., running thence West 3 miles; thence South 2 miles; thence East 2 miles; thence North 1 mile; thence East 1 mile; thence North 1 mile to the place of beginning; which when officially surveyed will probably conform to Sections Fifteen (15), Sixteen (16), Seventeen (17), Twenty (20) and Twenty-one (21), Township Twenty-seven (27) South, Range Twenty (20) East, S. L. M., containing 213 acres, more or less.

Also the acreage embraced within the mean high water mark on either side of the Colorado River, within the boundaries of the following described unsurveyed lands, to wit:

Commencing at a point which bears South 5 miles and West 4 miles from the Southwest corner of Section Twenty-six (26), Township Twenty-five (25) South, Range Twenty-one (21) East, S. L. M.,

running thence South 1 mile, thence East 1 mile, thence North 1 mile, thence West 1 mile to the place of beginning, which when officially surveyed will probably conform to Section Thirty (30), Township Twenty-six (26) South, Range Twenty-one (21) East, S. L. M., containing 55 acres more or less.

Also the acreage embraced within the mean high high water mark on either side of the Colorado River, within the boundaries of the following described unsurveyed lands, to wit:

Commencing at a point which bears South 9 miles and West 9½ miles from the Southwest corner of Section Twenty-six (26), Township Twenty-five (25) South, Range Twenty-one (21) East, S. L. M., running thence West 1 mile; thence South 2 miles; thence East 1 mile; thence North 2 miles; to the place of beginning; which when officially surveyed will probably conform to Sections Eighteen (18) and Nineteen (19), Township Twenty-seven (27) South, Range Twenty (20) East, S. L. M., containing 110 acres more or less.

Also the acreage embraced within the mean high water mark on either side of the Colorado River, within the boundaries of the following described unsurveyed lands, to wit:

Commencing at a point which bears South 10 miles and West 4½ miles from the Southwest corner of Section Twenty-six (26), Township Twenty-five (25), South, Range Twenty-one (21) East, S. L. M., running thence West 3 miles; thence South 1 mile, thence East 3 miles; thence North 1 mile to the place of beginning; which when officially surveyed will probably conform to Sections Twenty-two (22), Twenty-three (23) and Twenty-four (24), Township Twenty-seven (27) South, Range Twenty (20) East, S. L. M., containing 160 acres, more or less.

Also the acreage embraced within the mean high watermark on either side of the Colorado River, within the boundaries of the following described unsurveyed lands, to wit:

Commencing at a point which bears South 11 miles and West 7½ miles from the Southwest corner of Section Twenty-six (26), Township Twenty-five (25) South, Range Twenty-one (21) East, S. L. M., running thence West 2 miles; thence South 4 miles; thence East 1 mile; thence North 2 miles; thence East 1 mile; thence North 2 miles to the place of beginning, which when officially surveyed will probably conform to Sections Twenty-eight (28), Twenty-nine (29), Thirty-two (32) and Thirty-three (33), Township Twenty-seven (27), South, Range Twenty (20) East, S. L. M. and Sections Five (5) and Eight (8), Township Twenty-eight (28) South, Range Twenty (20) East, S. L. M., containing 280 acres, more or less.

Containing in all 988.00 acres, more or less, together with the right to use and occupy so much of the surface of said land as may be required for all purposes reasonably incident to the mining, operating, and removal of said minerals, upon the conditions laid down in Section 5575 x 5, Compiled Laws of Utah, 1917, as amended by Chapter 118, Laws of Utah, 1921, for an indeterminate period, upon the condition that at the end of each twenty-year period succeeding the first day of the year in which this lease is issued, such readjustment of terms and conditions may be made as the lessor may determine to be necessary in the interest of the State of Utah:

TO HAVE AND TO HOLD the above described premises unto the lessee, as herein provided, for the use and

purpose of prospecting, mining, drilling, boring, and operating for petroleum, oil, gas, naphtha, asphaltum, and kindred substances to which the State of Utah may be entitled, taking said products from said lands, laying pipe lines, maintaining rights of way and building all necessary and convenient tanks, stations, and structures.

ARTICLE I

It is expressly understood and agreed that this lease is granted subject in all respects to the conditions, limitations, penalties, and provisions contained in Chapter 118, Laws of Utah, 1921, and amendments thereto, which act is hereby made a part hereof to the same extent as if incorporated herein; and subject also to the conditions, limitations, penalties, and provisions of applicable federal statutes, and laws of the State of Utah, regarding the operation of oil and gas wells, Employer's Liability, Workmen's Compensation and Workmen's Insurance.

ARTICLE II

It is further expressly understood and agreed that the prospecting and mining rights and privileges leased as aforesaid shall extend to and include only petroleum, oil, gas, naphtha, asphaltum, and kindred substances, and that no rights or privileges respecting any other kind or character of mineral or minerals are granted or intended to be granted by this lease, but the lessee, shall promptly notify the lessor of the discovery of any valuable mineral other than petroleum, oil, gas, naphtha, asphaltum, and kindred substances in the course of his prospecting or mining operations hereunder.

The lessee, in consideration of the lease of the rights and privileges aforesaid, hereby covenants and agrees as follows:

First. To pay to the lessor an annual rental for each acre covered by this lease the sum of Fifty (50) cents per acre per annum in advance on the 2nd day of January of each year except the first year's rental, which is payable upon the execution of this lease, such rental to be credited on the royalties to become due hereunder during the year for which said rental is paid.

Second. To pay to the lessor a royalty of 12½% of all petroleum, oil, gas, naphtha, asphaltum, and kindred substances derived from said premises, or the value of the same at the market price thereof, at the option of the lessor, payable by the 15th day of each calendar month next succeeding the pumping or mining of said products.

Third. To commence actual prospecting or mining operations upon the land included herein on or before June 1, 1926, and thereafter to diligently prospect for, develop, and mine the petroleum, oil, gas, naphtha, asphaltum, or kindred substances in or upon said premises, and to properly and efficiently case every well on the leased premises with good and proper casing, when essential to the future protection of the well, and at all times to efficiently plug and keep such well or wells protected in proper manner, and to pump and work any well or wells, which shall prove to yield oil in paying quantities, faithfully and with good and sufficient machinery and appliances, so long as the said well or wells continue to yield oil in remunerative quantities, or until the termination of this lease, without expense to the lessor, and to submit annually, at the expiration of each year, a report

under oath, as to the amount and character of the prospecting and mining operations performed hereunder.

Fourth. Not to assign this lease or any interest therein, nor sublet any portion of the leased premises, or any of the rights and privileges herein granted, without the consent of the lessor first had and obtained.

Fifth. To install appliances for accurately measuring the quantity of petroleum, oil, gas, naphtha, asphaltum, or kindred substances extracted, used, sold, or shipped hereunder from said premises, and to keep an accurate record thereof and to furnish the lessor with a sworn statement thereof not later than the 15th day of each calendar month next succeeding the production of said petroleum, oil, gas, naphtha, asphaltum, or kindred substances.

Sixth. The party of the second part agrees to properly offset any producing well drilling within 200 feet of the boundaries of this property by commencing drilling operations not later than sixty days after discovery of commercial production in said well on adjacent land, and agrees to diligently prosecute drilling of such offset well to completion.

ARTICLE IV

The lessor hereby excepts and reserves from the operation of this lease the right to permit for joint or several use such easements or rights of way upon, through, or in the lands hereby leased as may be necessary or appropriate to the working of other lands belonging to the lessor containing mineral deposits, and the treatment and shipment of the products thereof, by and under authority of the lessor or its lessees; also, the right to use, lease, or dispose of the surface of the said lands.

ARTICLE V

It is expressly understood and agreed that this lease is conditioned upon the payment of the rent annually in advance on the second day of January of each year, except the first year's rental, which is payable upon the execution of this lease; and upon the payment of the royalties as herein provided and upon the compliance with all other conditions, provisions, and covenants set forth, and that upon failure to pay said rent or royalties, or upon failure to comply with any of the conditions, provisions, or covenants of this lease, the lessor may, at its option, after thirty days' notice by registered mail, cancel the lease. And it is further understood and agreed that upon failure or refusal of the lessee to accept the readjustment of terms and conditions demanded by the lessor at the end of any twenty-year period, such failure or refusal shall work a forfeiture of the lease and the same shall be cancelled, and the lessee, upon notice of cancellation or forfeiture, shall forthwith remove such surface improvements or property of the lessee, which can be removed without injury to the workings necessary to the future operation of the property, for any purpose, both surface and underground, from the premises, except the casings of wells which may have been driven and producing oil which shall not be removed, and surrender possession of the leased premises to the lessor, including all underground workings in such order and condition as to permit of the continued operation of the prospecting, drilling, boring, or mining operations, or other workings performed on said premises.

ARTICLE VI

It is mutually understood and agreed that the suspension of prospecting, drilling, boring, or mining operations by the lessee, for a longer period than two months, without the consent of the lessor, shall be cause of forfeiture, and the lessor may declare a forfeiture thereon and enter and take possession of the premises, provided that if the lessee shall be unable to continue prospecting, drilling, boring, or mining operations for any cause, not due to the fault or negligence of the lessee, the lessee shall be entitled to a suspension of operations until discontinuance of such cause of suspension, but no suspension of payments hereunder shall be granted.

ARTICLE VII

It is mutually understood and agreed that the lessee may terminate this lease at any time upon giving three months' notice in writing to the lessor, and upon payment of all rents and royalties and other sums due and payable to the lessor, and upon complying with the terms of this lease with respect to the casing and plugging of wells driven and the preservation of the prospecting, drilling, boring, or mining operations, or other workings, performed on said premises, in such order and condition as to permit of the continued operation of the said prospecting, drilling, boring, or mining operations, or other workings.

ARTICLE VIII

It is understood and agreed by and between the parties hereto that the lessor, its officers and agents, shall have the right at all times to go in and upon the leased lands and premises, during the term of said lease, to inspect the work done and the progress

thereof on said lands and the products obtained therefrom, and to post any notices on the said land that it may deem fit and proper; and the lessee shall also permit any authorized representative of the lessor to examine all books and records pertaining to operations under this lease and to make copies of and extracts from the same, if desired.

ARTICLE VIII-A. (See below)

ARTICLE IX

It is mutually understood and agreed by the parties hereto that all of the terms, covenants, conditions, and obligations in this lease contained shall be binding upon the heirs, executors, administrators, successors, and assigns of the lessee.

IN WITNESS WHEREOF, each of the parties hereto have executed this lease and agreement in duplicate, the day and year first above written.

STATE OF UTAH, *Lessor.*

By J. T. OLDROYD,
Executive Secy. State Land Board.

TEXAS PRODUCTION COMPANY,
Lessee.

By FRED W. FREEMAN, *Vice President.*
By P. E. FIELDS, *Asst. Secretary.*

Attest:

J. W. MCCANN,
Chief Clerk.

ARTICLE VIII-A

It is understood that the title to said lands of the State of Utah may be disputed by the United States or those claiming under it. Pending active litigation involving the title to said lands of the State of Utah or its right directly or through a lessee to develop and

operate said lands for oil and/or gas and to produce said products from said lands, instituted either by the United States or those claiming under it, or by the State of Utah or Texas Production Company as its lessee, the requirement of actual drilling on said lands shall be suspended, and also all other operations or activities on said lands; provided, however, that in spite of such litigation, Texas Production Company shall nevertheless pay to the State of Utah the rentals hereinabove provided.

It is further understood and agreed that in the event of any such litigation so involving the title of the State of Utah to said lands or its right directly or through Texas Production Company as its lessee to develop and operate said lands for oil and/or gas and to produce said products therefrom, Texas Production Company will at its own cost and expense and without cost or expense to the State of Utah defend or prosecute such litigation as the case may be.

COMPLAINANT'S EXHIBIT 631

PRELIMINARY STATEMENT OF T. G. WIMMER

SALT LAKE CITY, UTAH,
October 4, 1928.

I first went to Greenriver to reside there in about 1900. I became interested in the ranch that I still own about 25 miles below Greenriver, Utah, on the Green River early in 1906. From that time up to the present time I have been on the river practically every year. I have operated boats between Greenriver, Utah, and the junction of the Green River and the Colorado and from the junction of the Green and the Colorado to Moab many times. I have also operated boats from below the cataracts down to Lees Ferry. I was the head boatman with the party of engineers that included H. W. Dennis, chief engineer of the Southern California Edison Company; R. E. Caldwell, State Engineer of Utah; and Franklin Thomas in September, 1922. I also had charge of taking the equipment in and out for the United States Reclamation Service during the summer, fall, and winter of 1914. This was at the time the Reclamation Service made their drilling tests for a dam site at the junction of the Colorado and the Green.

I was on the old boat, *Clift Dweller*, when it came back up the Green River on its trial trip. This trip was only from my ranch 25 miles below Greenriver to Greenriver. While going, we had to put out the winch and pull boat up stream a number of times even under good water conditions. Boats of this character are not the proper boats for the Colorado

or the Green Rivers, but, as described in one of the following paragraphs, the boat for successful river operation on the Green and the Colorado Rivers must be of a shallow draft flat bottom design that can be successfully operated in the low stages of the river.

I have operated boats many times between Greenriver, Utah, and my ranch, both downstream and upstream, but boat operation in this 25-mile stretch is difficult on account of the riffles making shallow water, as the river has so much fall it is so shallow that it is hard to get over them. From my ranch on down to the junction of the Green and the Colorado, I believe that properly designed, flat-bottom scows so designed that they would not draw over 18 inches loaded could be operated both upstream and downstream in low water. Especially if this operation was constant so that the channel could be observed, because in this stretch of the river, which is also true of the Colorado from the junction to Moab, the main volume of water may be in several channels. Going downstream, it is sometimes difficult to pick the proper channel that will carry you through as the water from the various channels runs over the bars, finally converging into one channel. Coming upstream, this is not difficult to determine as practically any channel that you enter you can follow through. In coming upstream, we often try to keep close to the shore where the water is more quiet than out in the open river. In going up this shore passage, we must exercise care not to go onto the bar or riffle that causes this quiet water. Due to the river being crooked, we usually try to follow the bank where the still water forms; but, before we get to the diverting point that turns the river channel across, we have to turn out in the main channel because there will be a bar from behind this diverting

point which might trap us. With larger boats, we don't use this channel so much on account of the brush and driftwood coming in there. This we use only with the outboard motors.

During the drilling made by the Reclamation Service, we hauled supplies and coal down the river from Greenriver to my ranch with wagons. We did this because we could not get our freight scow up the river beyond my ranch at the mouth of the San Rafael. From this point on down, we used a scow about 12 x 20 feet drawing not over 18 inches of water. We pushed this scow ahead of a 33-foot launch. This launch was a stern-wheel launch. Our average time from my ranch down to the junction would be about seven or eight days for the round trip, and we would haul as high as ten tons on the scow. At the time we brought the machinery and equipment back to Greenriver from the junction, we put the steam engine that they used for drilling purposes on this scow, rigged up a stern-wheel, and that pulled itself up to my ranch under its own power. The balance of the equipment was loaded on the drilling scows and was pushed back up to my ranch ahead of the launches. We were four days coming from the junction to my ranch with the drill and drilling equipment. We had very little trouble with sand bars as at that time we were running the river regularly and had the channel pretty well mapped out. You see, as the river recedes it naturally forms a sand bar behind the projecting points and the channel still remains fairly good in lower water. In fact, I think the channel is more discernable in medium low water than it is in right high water.

As the water recedes, it deposits silt, and then when the current begins to get bigger it washes it away. We can navigate then, but we are more liable in exceedingly high water to run across a bar in the center of the stream because of the channel going to one side or other. We avoid, even in low water, of camping on these sand bars, if the river, due to rain or anything else, should rise in the night, which I have known it to do, it changes its course immediately and will come against these bars and what looked like a safe landing the night before and a pleasant place to camp is a great, big river.

You can not depend upon boating in the winter because the ice will form. I have seen it jam after the warm chinook wind would cause the river to break up, and would come down to the portion of the canyon that would shade it and hadn't broken yet. The upper ice would form against this ice and dam the river completely up on its original channel and turn it around a sand bar, and at the point where the river would flow back in again it would have a fall of ten feet.

The feasibility of boat operation from Moab to Greenriver for commercial purposes such as the hauling of farm produce and freight is not a feasible proposition now or ever. The operation of boats for tourist traffic in portions of these rivers, in my estimation, would be feasible. From the mouth of the San Rafael where my ranch is located on down to a few miles above the junction there are a great many nooks and coves that vary from a hundred acres or less to several hundred acres that can be successfully farmed and irrigated by reasonable pumping lifts

from the Green River. This total acreage might go to as much as 10,000 acres. I have had this area estimated as I have done more or less work with the idea in view of reclaiming this irrigable land along the Green River.

T. G. WIMMER,
523 South Third East St., Salt Lake City, Utah.
3358 Los Floras Ave., Lynwood, Calif.

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COMPLAINANT'S EXHIBIT 633

E. T. Wolverton, Civil and Mining Engineer Surveys, Drafts, Maps, Green River, Utah

CAMP RICO, UTAH,
HANKSVILLE, P. O.
June 17, 1929.

Mr. A. D. RYAN,
IRRIGATION ENGINEER,
322 Federal Building, Salt Lake City, Utah.

DEAR SIR: Your favor of May 24th just came to hand.

Am returning your paper entitled "General instructions relative to the interview of witnesses."

Answers to questions, together with drawings and sketches necessary to make my statements understandable by an ordinary person would take more time that I am at liberty to donate just at present.

The rivers indicated are not navigable on a commercial basis, but under stress of necessity certain stretches may be negotiated with light-draft boats of certain types.

I am willing to be called as a witness providing some provision can be made whereby I shall be remunerated for such service as I am able to render.

My elder son, N. E. Wolverton of Palisade, Colorado, has been interested with me in all my experiments with different types of boats, has been a helper on all my surveys, and was with me on all but one exploration trip.

My younger son, T. S. Wolverton of Palisade, Colorado, was with me on many boating trips.

Either one or both may be able to assist you somewhat.

One point which it might be well for the Government to bring out, is the danger to navigation from falling rocks.

During the early spring months and also in stormy weather the danger is ever present.

No warning is given.

Sometimes those rock falls contain many thousand tons, and coming off a cliff several hundred feet in height attain a high speed, often crossing the streams.

Sincerely yours,

E. T. WOLVERTON.

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53.	Chart, Rain Chart of the United States, by Charles A. Schott (with Powell report)	1	103
54.	Map, Department of Interior Map of Utah Territory, 1878, from J. W. Powell's book	1	103
55.	The Colorado River Plateau, by A. A. Baker, U. S. Geol. Survey. Manuscript report on the geology, topography, and geography; 13 pages text, 1 plate, 46 photographs	1	103
56.	Water Supply Paper No. 538, The San Juan Canyon, Southeast Utah. A geographic and hydrographic reconnaissance, by Hugh D. Miser. G. P. O., 1924	1	128
57.	U. S. Geological Survey Bulletin No. 751, Part (D), Geologic Structure of San Juan Canyon and Adjacent country, Utah, by Hugh D. Miser	1	128–129
58.	U. S. Geological Survey Water Supply Paper No. 395, Colorado River and its Utilization, by E. C. LaRue. G. P. O., 1916. 231 pages, and 25 pages of plates	1	129
59.	Contributions to the Hydrology of the U. S., U. S. Geological Survey Water Supply Paper No. 400, G. P. O., 1916, Part (C), The Measurement of Silt Laden Streams, by R. C. Pierce, 39–51	1	129

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60.	U. S. Geological Survey Water Supply Paper No. 162, Destructive Floods in the United States, 1905, with a discussion of flood discharge and frequency, by E. C. Murphy; pages 38–51 discusses spring floods in Colorado River Basin	1	129–130
61.	U. S. Geological Survey Bulletin No. 166, A Gazetteer of Utah, by Henry Gannet. G. P. O., 1900	1	130
62.	U. S. Geological Survey Water Supply Paper No. 556, Water Power and Flood Control of the Colorado River below Greenriver, Utah, by E. C. LaRue, G. P. O., 1925. 176 pages, 79 plates	1	130
63.	U. S. Geological Survey Water Supply Paper No. 380, The Navajo Country. A geographic and hydrographic Reconnaissance of Parts of Arizona, New Mexico, and Utah, H. E. Gregory. G. P. O., 1916. 219 pages, 29 plates	1	130
64.	Manuscript copy of reports on irrigation on Colorado and Green River Basins. C. A. Bissel, U. S. Reclamation Service	1	130–131
65.	U. S. Geological Survey Water Supply Paper No. 617, Upper Colorado River and Its Utilization (Robert Follansbee). G. P. O., 1929. 394 pages of text, 13 plates. Discusses the present and probable future utilization of Colorado River above its junction with the Green River	1	131
66.	U. S. Geological Survey Water Supply Paper No. 249, Stream Flow in Colorado River Basin, 1907–1908. G. P. O., 1910	1	133

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67.	U. S. Geological Survey Water Supply Paper No. 269, Stream Flow in Colorado River Basin, 1909. G. P. O., 1911	1	133
68.	Silt in the Colorado River Basin, Technical Bulletin No. 67, U. S. Department of Agriculture (Fortier and Blaney). G. P. O., February, 1928	1	133
69.	U. S. Geological Survey Professional Paper 132 (C), Notes on the Geology of Green River Valley, between Green River, Wyoming, and Greenriver, Utah. (J. B. Reside, jr.). Pages 35–50. G. P. O., 1925	1	133
70.	Map showing Navajo and Hopi Indian Lands in Southeastern Utah. Department of the Interior	1	134
71.	Certified copies of Executive orders setting aside Navajo and Hopi Indian lands in southeastern Utah	1	134
72.	Colorado River of the West. Report by Lieutenant Joseph Ives, U. S. Army, 1861, published by order of the Secretary of War	1	134–135
73.	Lower Colorado River west of the 110th meridian. Report by Capt. Geo. M. Wheeler, Corps of Engineers, U. S. Army, prepared under the direction of Chief of Engineers, 1889	1	135
74.	U. S. Geological Survey Professional Paper 132 (A), Rock Formations in the Colorado Plateau of Southeastern Utah and northern Arizona. (Longwell, Miser, Moore, Bryan, and Paige.) Pages 1–23. G. P. O., 1925	1	135

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75.	Report of Special Survey and Examination of Colorado and Green Rivers between Greenriver and Moab, Utah, by W. G. Hoyt, U. S. Geological Survey; 78 pages of text and tables	1	139
76.	Plates 1–37. Bars and Riffles, accompanying special report by W. G. Hoyt, Complainant's Exhibit 75	1	146
77.	Photographs 1–172 of Colorado and Green Rivers, accompanying special report by W. G. Hoyt, Complainant's Exhibit 75	1	146
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79.	Charts showing variations in stream flow, Colorado, Green, and San Juan Rivers at certain gaging stations (1901–1907)	1	150
80.	Report on Rapids, Rapid Water, and Quiet Water, Colorado, Green, and San Juan Rivers, compiled by W. G. Hoyt, U. S. Geological Survey; 21 pages text and tables		
81.	"The Colorado River," by Lewis R. Freeman	2	245
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85.	Brief description of Colorado, Green, and San Juan Rivers and tributaries, compiled from Water Supply Papers and River Survey Maps by W. G. Hoyt, U. S. Geological Survey	2	250
86.	Report on Special Survey and Examination of San Juan River at the Line between the States of Colorado and Utah, by W. G. Hoyt, U. S. Geological Survey; 59 pages of text and tables	2	265–268
87.	Appendix (A)—Photographs 1–13 and Plate 1, to accompany surveys and examinations of San Juan River and to accompany complainant's Exhibit 86	2	251–255
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89.	U. S. Geological Survey records, daily and monthly discharge Colorado River near Cisco, 1914–17 and 1923–28	2	260
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In the Supreme Court of the United States

OCTOBER TERM, 1[redacted] 1928

THE UNITED STATES OF AMERICA, PLAINTIFF

v.

THE STATE OF UTAH, DEFENDANT

BILL OF COMPLAINT, TOGETHER WITH PROOF OF MAILING, MOTION FOR LEAVE TO FILE, AND NOTICE OF SUBMISSION OF MOTION.

U. S. GOVERNMENT PRINTING OFFICE: 1928